

**Development and validation of recipes using consumers' terms obtained
through the application of the Think Aloud technique**

by

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Abstract

Cooking is part of almost everyone's daily life. During cooking, recipes are usually used as a guide for home cooks to help them take decisions and get a tasty and appealing food product. Recipes have a great impact on consumers' behavior and decision making at the kitchen. However, building a recipe requires understanding of the potential user, including explaining to him/her, in layman's terms, the best way to prepare the food product. Nevertheless, what is the best way to communicate to consumers through a recipe? A qualitative sensory technique that allows collecting data regarding people's motivations and actions during cooking is required in order to retrieve this information. The technique needs to allow data collection about the motivations, and the actions inspired by these. Recipes can use these motivations and actions to communicate to recipe users. This research proposes the use of the Think Aloud method, a technique that has not been used on sensory research, as a technique that can meet these goals.

The objective of this study was to develop and evaluate different recipe styles for the preparation of doughs by understanding and using people's descriptions, techniques and preparation terms through the application of the Think Aloud technique.

Two qualitative studies were performed with wheat dough preparers (n=43) recruited in Manhattan, KS and corn dough preparers (n=50) recruited in Guadalupe, Costa Rica. During the interviews, participants verbalized the process of preparing the doughs, as well as their decision-making process through the Think Aloud technique.

Results showed that participants provided enough data by thinking aloud. It was observed that the use of the Think Aloud method allowed them to be aware of texture characteristics in the dough. The ready doughs were mainly described as *not sticky*, *soft* and *pliable*. The most common techniques used to make the doughs included *stirring*, *pushing/pressing/squeezing*, and

incorporate all together. Five recipes were written based on these descriptions. Three of the recipes included a step-by-step numbered format with a different amount of detail: not detailed, very detailed, and detailed recipe. The other two formats, both based on the detailed recipe, included a paragraph form recipe and a recipe with images. Wheat and corn recipes were validated in two online surveys (per study, n=300) where respondents evaluated the easiness, likeability, likelihood of using the recipe, helpfulness of the format, and amount of information. Overall, respondents considered the recipe with images easier and more helpful. The very detailed recipe was considered more difficult, less helpful and was liked less than the other recipes.

Understanding and identifying the words and techniques people use at the kitchen represent a useful tool that can be used to communicate to other preparers how to make a food product. The Think Aloud technique represents a useful technique to collect information regarding consumers' actions and motivations. The data collected through the application of the technique allowed building different recipe styles to communicate to consumers how to prepare a food product.

Table of Contents

List of Figures	viii
List of Tables	ix
Acknowledgements	x
Chapter 1 - Literature Review.....	1
Dough development	1
Wheat dough development	2
Corn dough development	4
Sensory and rheological analysis of doughs	4
Qualitative studies of doughs	6
Effective communication: developing recipes for consumers	7
Consumers following recipes.....	10
Following dough recipes	11
Think Aloud technique	12
Cognition process and thinking aloud.....	12
Use of the Think Aloud technique in qualitative research.....	15
Research Objectives.....	16
References	17
Chapter 2 - Development and validation of a recipe method for doughs.	24
Abstract	24
Introduction.....	25
Materials and Methods.....	26
Qualitative study	26
Subjects recruiting	26
Participants' demographics	27
Dough preparation	27
Post session interview	29
Moderators	29
Recipes validation	29
Online survey	30

Participants.....	30
Data analysis	31
Qualitative study	31
Online survey	32
Results and Discussion	33
Preparation process	33
Measurement of ingredients.....	33
Mixing and kneading	35
Description of a ready dough.....	38
Recipe validation	42
Easiness of the recipe.....	46
Likelihood to use the recipe at home	47
Perceived amount of information given in the recipe.....	48
Likeability of the instructions	49
Helpfulness of the format.....	50
Cluster analysis	51
Liking and disliking factors in each recipe	52
Liking factors in each recipe.....	54
Disliking factors in each recipe.....	56
Practical applications	58
Limitations	58
Conclusions.....	59
References.....	59
Chapter 3 - Use of the Think Aloud Technique in Qualitative Sensory Analysis: A product	
preparation study	64
Abstract.....	64
Practical application.....	64
Introduction.....	65
Materials and methods	67
Application of the Think Aloud Technique in a dough preparation study	67
Post session interview	69

Moderators	69
Data analysis	69
Results and Discussion	70
Practical Applications	78
Limitations	78
Conclusions.....	79
References.....	79
Appendix A - Basic, not detailed recipes given during observational studies.....	82
Wheat dough recipe	82
Corn dough recipe.....	82
Appendix B - Materials for data collection during dough preparation sessions.....	83
Wheat dough study	83
Observation worksheet.....	83
Post session interview	84
Corn dough study.....	85
Observation worksheet.....	85
Post session interview	86
Appendix C - Cooking habits of participants	87
Dough preparation studies	87
Online surveys	87
Appendix D - Qualtrics survey	89
Start of Block: Screener	89
End of Block: screener.....	90
Start of Block: Recipe validation.....	91
End of Block: Recipe validation.....	94
Start of Block: Demographics.....	94
End of Block: Demographics.....	96
Appendix E - Contingency tables built from CATA data.....	97
Appendix F - Correlations and cluster analysis of recipes validation	99
Pearson's correlations	99
Appendix G - Recipes validates.....	100

Wheat recipes.....	100
Not detailed, step by step format, wheat recipe	100
Very detailed, step by step format, wheat recipe	101
Detailed, step by step, wheat recipe	103
Detailed, paragraph format wheat recipe	105
Detailed, image format, wheat recipe	106
Corn recipes	108
Not detailed, step by step format, corn recipe	108
Very detailed, step by step format, corn recipe	109
Detailed, step by step, corn recipe	111
Detailed, paragraph format corn recipe.....	112
Detailed, image format, corn recipe.....	113

List of Figures

Figure 2.1. Pictures of dry and wet ingredients mixed during the wheat dough preparation.	41
Figure 2.2. Pictures of dry ingredients mixed during the wheat dough preparation.....	41
Figure 2.3. Easiness of the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.	46
Figure 2.4. Likelihood to use the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.	47
Figure 2.5. Perceived amount of information in the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.	48
Figure 2.6. Likeability of the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.	49
Figure 2.7. Helpfulness of the format of the recipes (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.....	50
Figure 2.8. Likeability of recipe instructions per cluster for the wheat study.	51
Figure 2.9. Likeability of recipe instructions per cluster for the corn study.....	52
Figure 2.10. Correspondence analysis factor map representing 5 wheat recipes and 18 liking factors.....	54
Figure 2.11. Correspondence analysis factor map representing 5 corn recipes and 15 liking factors.....	55
Figure 2.12. Correspondence analysis factor map representing 5 wheat recipes and 18 disliking factors.....	56
Figure 2.13. Figure 7. Correspondence analysis factor map representing 5 corn recipes and 15 disliking factors.....	57

List of Tables

Table 2.1. Demographic information of 43 wheat dough preparers and 50 corn dough preparers who participated in the studies.....	27
Table 2.2. Amount of ingredients given to dough preparers.	28
Table 2.3. Demographic information of participants of the online surveys (per study, n=300)...	31
Table 2.4. Measurement techniques mostly used by 43 wheat dough preparers and 50 corn dough preparers during the dough preparation sessions.	34
Table 2.5. Amount of each of the ingredients (g) used by 43 wheat dough preparers and 50 corn dough preparers during the dough preparation sessions.	35
Table 2.6. Utensils used by 43 wheat dough preparers and 50 corn dough preparers in each of the mixing stages during the dough preparation sessions.	37
Table 2.7. Mixing and kneading techniques used by 43 wheat dough preparers and 50 corn dough preparers during the dough preparation sessions.	38
Table 2.8. Attributes and terms used by 43 wheat dough preparers and 50 corn dough preparers to describe a ready dough.....	40
Table 3.1. Techniques mentioned and observed by participants when preparing a wheat dough (n=43) and a corn dough (n=50).	71
Table 3.2. Techniques mentioned and observed by participants when preparing a wheat dough (n=43) and a corn dough (n=50) (continuation).	72
Table 3.3. Advantages, disadvantages, needs and remedies of the application of the Think Aloud technique in a sensory research.....	76
Table 3.4. Advantages, disadvantages, needs and remedies of the application of the Think Aloud technique in a sensory research (continuation).	77

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Chapter 1 - Literature Review

Cooking is still a very important part of everyone's life, and even a hobby for many people. Up to 44% of consumers mention they like cooking. The percentage is even higher when you look at Millennials (a person born in the 1980s and 1990s) and foodies (people with an avid interest on food trends and trying new foods). Two thirds of Millennials and 56% of foodies mention they enjoy cooking. About 69% of consumers prepare dinner at home at least five nights a week and 35% mention they do it from scratch. Cooking from scratch is yet an important part of eating at home, in a national survey, 78% of respondents comment that eating at home means cooking from scratch (Krohn, 2016; Sloan, 2013; Sloan, 2015; Sloan, 2017).

Products where a dough needs to be prepared, including baked goods, empanadas, tortillas, and other cooked goods, are still a main component of people's diet (Laudan, 2001). However, when preparing these products from scratch, consumers frequently have some doubts about the preparation process and adequate techniques.

Dough development

Dough is mainly a combination of flour, water and energy. Cauvain (2012) describes dough as a semi-solid mass that resists mixing. During dough preparation, the water added to the flour causes the proteins and starch granules present in the flour to swell; and due to the mechanical energy applied, the proteins organize into a continuous matrix, giving the dough viscoelasticity. Before forming the dough, the ingredients need to be mixed in; this allows ingredients to be blended into a homogeneous mass (Schluentz, 1997). Research shows that dough quality, formulation, mixing and/ or kneading processes have a high impact on the quality of the final product; that is why, dough development is a key part whenever preparing breads, cakes, tortillas, empanadas, cookies, etc. (Lin, 2008).

The characteristics of doughs differ among the different types of flours. Wheat flour develops a viscoelastic dough with high extensibility through the development of the gluten matrix. Rye flour also develops gluten, but the extensibility is a lot less than that of wheat dough (Autio & Salmenkallio, 2001; Cauvain & Young, 2007). Other kind of flours cannot form this complex matrix. Rice flour for example, requires a very high hydration in order to achieve a suitable consistency for bread making; still, the dough exhibits little stickiness and poor cohesiveness (Dal Bello & Arendt, 2011; Dixit & Bhattacharya, 2015). Corn dough, on the other hand, is used for tortillas and chips instead of bread making, and it is characterized by its adhesiveness and stickiness (Dal Bello & Arendt, 2011; Ramirez-Wong, Sweat, & Rooney, 1992).

Wheat dough development

A wheat dough is obtained when a mixture of wheat flour and water (usually 1:3 ratios w/w) is kneaded; this mix contributes to the formation of the cohesive, rubbery mass, or dough (Rahimi, 2011). The main ingredients for preparing wheat doughs are flour, water, salt and yeast (Cauvain & Young, 2007). Dough can be prepared by direct or indirect addition; in the direct addition, the ingredients are directly mixed together. In the indirect addition, yeast is pre-fermented in a mix of flour, water and sugar; and after a given time it is added to a bulk of flour and other ingredients that will be in the dough (Belitz, Grosch, & Schieberle, 2009).

During mixing, as water is added to the flour, protein molecules begin to unfold, swell and distribute heterogeneously. This hydration softens the protein network; the starch granules become less firmly attached to the proteins, but still attached. At this point, dough is a composite containing elastic gluten-rich and starch-rich regions (Bot & Bruijne, 2003; Gajula, 2017; Schiedt, Baumann, Conde-Petit, & Vilgis, 2013).

After this step, all the ingredients are unified to give a homogeneous dough. Lipids, from the flour as well as others that could be added, are uniformly distributed and brought into contact with the protein fibers. Soluble materials (such as salt or sugar), are fully dissolved and distributed in the aqueous matrix (Gajula, 2017).

The next step is kneading; during this step the mix is rolled, deformed and stretched, resulting in the formation of gluten. This stage is commonly known in the literature as dough development, since it is the stage where the gluten is formed (Manley, 2000; Rahimi, 2011). Gluten is a water insoluble protein complex formed mostly by two proteins, gliadins (characterized for being viscous and extensible), and glutelins (characterized for their elasticity). When mixed with water, these proteins form a cohesive, elastic, cross-linked network that traps carbon dioxide produced by yeast during fermentation, proofing and baking. This allows the mass to expand and become softer and lighter (Gajula, 2017; International Food Information Service, 2009; Owens, 2001).

During kneading, the thick, viscous “slurry” obtained after mixing receives energy input and becomes a smooth and viscoelastic dough (Gajula, 2017; Rahimi, 2011). When it is done by hand, it is performed by pressing down the dough with the heels of the hands and pushing it away from the body; then the dough is folded in half, given a quarter turn. The pressing and pushing continues until the dough is ready (International Food Information Service, 2009). During this stage, the starch-rich regions yield to stress. The gluten begins stretching and starts binding more water at the same time that air is incorporated forming bubbles (Bot & Bruijne, 2003; Schiedt et al., 2013).

Corn dough development

Corn dough, commonly, known as *masa* in Latin American countries, is prepared by mixing corn flour and water. Before using the corn flour for the preparation of the dough, corn is cooked in alkali in a process called nixtamalization. During nixtamalization, corn is boiled in lime, which causes the removal of starch granules, and the rearrangement of the starch in the endosperm. At the same time, proteins in the corn are denatured. The alkaline cooking and steeping cause water and calcium to enter the grain. The lime permits a faster water absorption and distribution throughout the grain components, allowing the pericarp to become gummy and sticky. Because of this process, the dough has the desired characteristics of cohesiveness and adhesiveness (Clark, 2014; Hall, 2010).

The amount of water and ingredients used to prepare corn tortillas varies depending on the study; several studies suggest the addition of 115% of water to the corn flour. Salt, fat, and preservatives are some other ingredients commonly added (Calleja Pinedo & Valenzuela, 2016; Phillips, Pike, Eggett, & Dunn, 2017; Schiedt et al., 2013).

The corn dough is a matrix of dissolved starch molecules, and gelatinized starch granules in a water phase that also contains non-gelatinized starch granules, lipids, and non-starchy components. Corn dough for tortillas is characterized for its cohesiveness and elastic properties regardless of the absence of gluten (Rodriguez, Fernandez, & Ayala, 2005).

Sensory and rheological analysis of doughs

When studying doughs, most of the studies focus on the texture, rheology and microstructure of them. Springiness, firmness, cohesiveness and adhesiveness are some of the instrumental measurements done on doughs (Giese, 2003; Rodriguez et al., 2005). Some other

instruments, like the farinograph or the mixograph, measure the water absorption, time for dough development, dough stability, and the resistance to mixing (Rodriguez et al., 2005)

Measuring physical properties certainly provides valuable information about doughs to researchers. Rheological characteristics help predict the dough behavior under processing conditions such as flattening, sheeting, rolling and extrusion (Bhattacharya, Narasimha, & Bhattacharya, 2005). However, measurements need to be related also to how the dough behaves in the hands of users and preparers, how they describe it, and how it feels as it is mixed and/or kneaded (Civille & Szczesniak, 1973). Sensory science represents a useful way of understanding rheology and texture of doughs. Literature mentions that only human beings can perceive and describe sensory properties such as texture and rheology of food products (Giese, 2003; Szczesniak, 2002).

Few sensory studies have been performed to study doughs. Dixit and Bhattacharya (2015), used descriptive sensory analysis to study the sensory characteristics of rice flour doughs with different additives. Nine trained panelists analyzed three “non-oral” sensory attributes: hardness, stickiness and springiness. This panel concluded that a “moderate” hardness and springiness of the rice dough, along with low stickiness are desirable features in order to obtain a dough that can be flattened, shaped, rolled, or sheeted.

Bhattacharya et al. (2005) used 10 non-trained panelists to evaluate the hardness, cohesiveness, springiness and adhesiveness of corn dough. They found that moisture increments decrease the springiness and hardness of the dough, while the cohesiveness and adhesiveness increase.

Qualitative studies of doughs

Qualitative studies, as part of sensory analysis, are techniques that involve interviews or observational studies that are less structured than controlled laboratory experiments. This type of technique is most applicable for the exploration and development of new concepts, to understand consumers' terminology, describe the sensory attributes of a product, and to understand consumers' behavior (Lawless & Heymann, 2010; Meilgaard, Civille, & Carr, 2007).

Consumers' qualitative studies allow a better understanding of a product, as well as the identification of the characteristics that consumers perceive from it. This includes their points of view and experiences. Consumers' terms for describing changes in specific attributes provide an accurate guidance for further sensory studies. The use of qualitative research is recommended prior quantitative studies, especially before consumer studies. Qualitative research, as interviews or focus groups, allow the selection of suitable consumers terms that can be used in quantitative consumer tests (Muñoz, Chambers, & Hummer, 1996).

In 1937, David Katz performed a qualitative study to determine how English bakers judged a dough. Participants used the word "body" to describe wheat dough; Katz concluded that "body" was a term that included four properties that can be perceived with the senses: (1) the degree of stickiness; (2) the elasticity; (3) the resistance to tearing; and (4) the extensibility. Katz also found out that sight and touch are most responsible for providing sensory data for the bakers' judgements but smell and sound also play a smaller role on this judgement. From his study, it was determined that the nature and amount of sensory properties in a product might be different from those physical properties identified or measured in rheological instrumental tests (Mark & Stewart, 1958; Szczesniak, 1990; Szczesniak, 2002).

Sensory evaluation of foods usually studies the flavor, aroma, texture (mostly mouthfeel), and appearance of food products; nevertheless, as seen in the studies mentioned before, doughs sensory studies require the analysis of tactile handfeel. Tactile handfeel in foods is usually evaluated through utensils like a dough hook, or by manipulation with the hands. In sensory analysis, handfeel has been used for the evaluation of dulce de leche and mostly fabrics and textiles (Lawless & Heymann, 2010).

Besides Katz' study, there is no a scientific research that offers information on how household users prepare a dough, and how they describe it. How do users know a dough is ready? How do dough users describe the process of making a dough to people that have never done it? Anecdotal evidence from the industry and other sources, including cooking blogs, suggest that naïve consumers do not understand clearly how to make a dough. Some of their main concerns when preparing a wheat dough are that they do not know how long to knead, and that the bread ends up being tough, gummy or dense (Bernstein, 2014; Troyano, 2015). For corn dough, consumers complain of not getting pliable tortillas, as well as getting a dry and fragile product (Christensen, 2017; LaDonna, 2009).

Effective communication: developing recipes for consumers

The communication to consumers of how to prepare a food product, like a dough, has to be clear and targeted to a specific audience. Recipes represent an integral way to demonstrate principles for nutrition, for example, when they show nutrition facts or ideas for healthier food replacements; product preparation and food purchase. They represent a way of transferring theoretical instructions into practice. Recipes can be defined as a set of directions that tell the user how to cook and prepare a food product (Brunosson, Brante, Sepp, & Mattsson Sydner, 2014; Klenova, 2010; Maughan, Godwin, Chambers, & Chambers, 2016).

Recipes are a common source of information for consumers who like or want to cook; they can be found in blogs, cookbooks or magazines (Hertzler & Bruce, 2002; Maughan et al., 2016). The use of recipes is growing because families and foodies are eating more meals at home. A survey from the NPD group (2012), reported that 67% of consumers use a recipe once a month, being dinner the main meal where recipes are used.

In a study performed with college students, Hertzler & Bruce (2002), reported that family is the most frequent recipe source used by college students, followed by package labels and cookbooks. This shows why recipes can be instructions derived from oral and practical tradition, like family traditions where cooking was learned by imitation (Brunosson et al., 2014).

Providing accurate information on how to prepare a product is crucial for consumers' understanding and satisfaction. Flour packages for example, usually include recipes for the preparation of dough and baked/cooked products (cookies, bread, tortillas, empanadas, etc.). Therefore, the directions given in the package must provide accurate information to consumers for their success when using the product (Levis, Chambers, Chambers, & Hollingsworth, 1996).

Food science knowledge is desired since this allows better understating of the function of each of the ingredients (Landers, 2003). Directions in a recipe should be easy to read and follow, in layman's terms, and not cluttered (Levis et al., 1996; Shapiro, 1990). Recipes should include some key factors of the food preparation like temperature, ingredients to be added and/or mixed, variables during the process, and expected outcomes (Brunosson et al., 2014; Granberg, Brante, Olsson, & Sydner, 2017; Levis et al., 1996).

It is important to keep in mind to whom the recipe is addressed; recipes are usually written assuming that the consumer already has certain knowledge and skills on how to use a recipe. Some of these skills involve the understanding of numbers and fractions, measurement units, utensils,

symbols, and techniques. Some words like, stir, spatula, or knead might not have a meaning to some naïve users, and they might not know how to perform some actions like how to use the spatula or how to knead. Using consumers' terms or descriptions terms for the cooking process might make it easier for naïve users to understand, read, and follow recipes (Brunosson et al., 2014; Granberg et al., 2017; Levis et al., 1996; Norrick, 1983).

Recipes can be presented in different formats; they are usually structured with the list of ingredients first, followed by the instructional text (Brunosson et al., 2014). Levis et al (1996) studied three different types of structures in recipes: paragraph-form, numbered step-by-step, and a graphical/text format using focus groups. Results showed that consumers preferred the step-by-step because they considered it easy to read and follow. The graphical/text format was also liked by consumers because it was “eye-catching”, easy to follow and gave them confidence. The use of pictures and symbols is also useful when the users are children, or people with limited reading skills (Hertzler, 1983; Levis et al., 1996). However, when using graphics or images on recipes, is important to include captions with some written details, otherwise it is difficult for the consumer to prepare the product just following the images (International Organization for Standardization, 2012; Levis et al., 1996).

Bielunski (1994) directed a survey to explore what consumers want in recipes. Respondents mentioned they like recipes that seem easy to prepare. Interviewees mentioned they evaluate the easiness of the recipe by checking the number of ingredients, preparation time, and overall readability. They also mentioned that an easy recipe should include ingredients and utensils that are easy to find at home. Respondents were presented with different recipes and direction formats; they mentioned they liked recipes where the ingredients are break out and the recipes are presented in numbered steps or bullet points. Interviewees also preferred recipes with short and concise

directions, but still specific; these directions should include what to do and what not to do (like “do not overmix”) (Bielunski, 1994; Reed & Schuster, 2002).

Consumers following recipes

The number of consumers that enjoy trying new recipes increased by 32% from 2010 to 2015; foodies are more likely to enjoy following recipes if they are in video format or if they are offered step-by-step recipes with images (Sloan, 2015). Part of this increment is due Millennials since this generation reports a great enthusiasm towards cooking. Around half of Millennials use recipes at least once a week, making this group the main responsible for the growth in the use of recipes (Mintel, 2011; The NPD Group, 2012).

Recipes have a great impact on consumers’ behavior at the kitchen. For example, research shows that users have better food safety behaviors when recipes have food safety instructions in them compared to occasions when recipes do not have this kind of instructions (Maughan et al., 2016).

When it comes to users following recipes, the format of the instructions might not influence whether the consumers follow the instructions or not (Levis et al., 1996). However, readers have different reading patterns that include reading just the first items, reading only the instructions, or reading every word; this reading pattern does affect how consumers follow the whole recipe, or part of it (Fischhoff, 2013).

Some studies suggest that the person who taught the respondents how to cook, as well as the size of the family, does not have an impact on whether the user follows recipes or not (Kornbluh & Parke, 1965). On the other hand, the education level did have an impact on the use of recipes; users with less than an eight-grade education have shown to use more written recipes,

while college educated consumers used recipes mostly for inspiration and stimulation (Hertzler, 1983; Kornbluh & Parke, 1965).

It is recommended to evaluate or proof the instructions in a recipe before giving them to consumers. Experts who are independent from the recipe development or a panel of users can do the evaluation. Open-ended interviews are one of the best ways to validate the recipes, this might include the actual preparation of the recipe, but not necessarily (Fischhoff, 2013; International Organization for Standardization, 2012).

Following dough recipes

Multiple problems can happen while preparing yeast breads or tortillas, especially since these processes involve a complex mixture of ingredients, and preparation techniques. Most of the time, people use intuition to solve problems during dough preparation, and some of these have been passed on from family members, mentors or learnt through trial and error (Cauvain, 2017).

The main problems people have when working with doughs include low bread volume, which can be influenced by the dough temperature or the mixing process. Another problem are the holes or tunnels in the product, this can happen due to excessive mixing or kneading. Tough or stiff bread or tortillas is another main problem, which can be related to lack of water or inadequate mixing (Cargill, 2011; Cauvain, 2017). All these issues, could be clarified with clear and specific recipes that guide the user through the process, explaining him what to do, what not to do, and how the outcome should look, or feel.

Some of the confusions when following recipes for preparing doughs are for example, how to add the flour; if the user does not know that the flour needs to be added gradually, he/she could add all at once; while with tortillas water is usually added gradually. Another main concern is the time it takes for the dough to be ready; the use of a time measurement can be useful, but the user

should be able to understand the result. For example, if the recipe calls for the dough to be kneaded 5 minutes, it does not mean the dough will be ready after that time, this depends on the kneading technique, the type of flour, and the amount of flour and water added (Brunosson et al., 2014).

Think Aloud technique

Cognition process and thinking aloud

Few research techniques have access to cognitive processes, including what people talk to themselves (their inner speech), and how subjects acquire an idea. For some authors, the cognitive processes, and mainly inner speech, are almost inaccessible to research and experiments, this means that an important part of consumers' thoughts are usually not expressed to the researcher or moderator during focus groups, questionnaires or interviews (Chambers, Godwin, & Vecchio, 2001; Charters, 2003). Talking to oneself has shown to be associated with multiple emotional and cognitive behaviors, which could be useful source of information in qualitative research (Morin, Duhnych, & Racy, 2018; van Someren, Barnard, & Sandberg, 1994).

Self-directed speech plays an important role in problem solving, planning, and decision-making processes (Morin et al., 2018). The think-aloud method was introduced as a usability test that could explore inner speech making it external. Usability tests are methodologies that study if an application, process, or goal is effectively accomplished while using a product; it provides information of the user experience and knowledge, including the difficulties and thoughts about the process or product under evaluation (O'Bryan et al., 2010). Usability tests allow the consumer to have a direct, personal, and individualized contact with the product as they use it (Black, 2015; Charters, 2003).

The Think Aloud technique, helps explore the inner speech, it allows the researcher to collect insights of the knowledge and problem-solving methods of subjects. This technique

requires the users/consumers to talk and vocalize their thoughts while performing a task or solving a problem. The main advantage of the technique is that it produces direct information of the ongoing thinking process while the task is being performed; rather than asking questions about a past process (Benjafield, 1969; Charters, 2003; Morin et al., 2018; van Someren et al., 1994).

The Think Aloud technique is mainly used in qualitative research for the study of problem solving processes. The method permits the identification of (van Someren et al., 1994):

1. Differences in problem solving abilities and techniques between subjects
2. Differences between tasks
3. Effects of instructions

Using the Think Aloud technique involves the subjects using verbalization to describe their thinking process and thoughts to the interviewer or moderator (Benjafield, 1969; Charters, 2003). The Think Aloud technique has shown to give more information, and more words or terms, compared to other introspective protocols where the researchers need to design experiments that allow them to draw inferences as well as extensive questionnaires post-exercise (Benjafield, 1969; Jäkel & Schreiber, 2013).

Ericsson and Simon (1993) describe three levels of verbalization that the subject can use during the Think Aloud process. These levels are based on the fact that the information first needs to be sent to the brain's memory centers, then the organizational and verbalization processes occur allowing people to retrieve the information accurately (Chambers et al., 2001). The levels are described below (Boren & Ramey, 2000; Bruun & Stage, 2015):

1. Level 1: the subject makes no special effort to communicate his thoughts; at this level there is little, or nonintervention from the interviewer. The information

collected relies on short-term memory. An example of this will be verbalizing a sequence of numbers while solving a math problem.

2. Level 2: this level requires a further explanation of the thought content; there is more intervention of the interviewer without bringing new information into the subject's attention. As level 1, it relies on short-term memory. An example is, explaining an abstract concept or image.
3. Level 3: the subjects explain the thought processes; they explain their thoughts, ideas, and motives. It requires linking thoughts and information and more involvement from the moderator. For example, when the moderator filters the verbalization into a certain topic. In this case, information is retrieved from long-term memory (Boren & Ramey, 2000; Bruun & Stage, 2015).

On its original form, the Think Aloud technique relies on short-term memory using only levels 1 and 2 of verbalization. The initial theory, states that level 3 provides a distraction to the subject and uses, as mentioned, long-term memory (Boren & Ramey, 2000; Bruun & Stage, 2015; Ericsson, 1993).

Bruun and Stage (2015) studied four different protocols of the Think Aloud technique where consumers evaluated a data dissemination website. The protocols are listed as follow:

1. *Traditional*: supporting level 1 of verbalization. The interviewer just says, "Keep talking" when the interviewee stops talking.
2. *Active listening*: supporting level 2 of verbalization. The interviewer constantly provides acknowledgement to the interviewee by saying "Um-hum".
3. *Coaching*: supporting level 3 of verbalization. The moderator is in a continuous conversation with the subject.

4. *Silent*: not associated to the verbalization levels, there is no interaction between the moderator and the interviewee besides the initial explanation of the task, and the respondent is not asked to Think Aloud; this was use as a base line for comparison (Bruun & Stage, 2015).

Results showed that the protocol does not influence the effectiveness and the efficiency of the tasks. The number of problems identified was the same using Traditional, Active listening and Coaching protocols, but significantly higher than the Silent protocol (Bruun & Stage, 2015).

It is recommendable for the Think Aloud technique to give the subject a warm up exercise. Even when overall, people do not have a lot of difficulty expressing their thoughts, some could. The warmup exercises are problems the subject needs to solve using the Think Aloud technique (Ericsson, 1993). During the warmup, the interviewer has more freedom to interfere and re-explain the technique. This process can take up to 15 minutes; if after 15 minutes the person is unable to express his thoughts, it is recommendable to stop the interview (Chambers et al., 2001; van Someren et al., 1994).

Use of the Think Aloud technique in qualitative research

Computer science is one of the fields where the Think Aloud technique has been used the most (van Someren et al., 1994). This field uses the Think Aloud technique to understand the problems or issues people run into when using an application, program or website. When users evaluated a data dissemination website using the Think Aloud technique, multiple usability problems were identified. Some of the problems were: misunderstanding of the headers on columns and rows, difficulty visualizing the information, and clicking on the wrong places to obtain the desired information (Bruun & Stage, 2015).

The technique has also been used in the medical field. Forsberg et al. (2014) studied the clinical reasoning of pediatric nurses using virtual patients. The results showed that virtual patients can be used for clinical evaluation and for training the nursing students. The researchers also got a better understanding of the decision-making process nurses go through when evaluated the patients' cases.

There have been few applications of the technique in consumer science. Senoo (2005) evaluated two cosmetic foaming cleansers by paired comparison using the Think Aloud technique. Using the technique in a preference test allowed the researcher to have straightforward data while consumers used each of the cleansers. Chambers et al. (2001) used the Think Aloud technique to determine the cognitive processes used by consumers to estimate portion sizes. The technique allowed the researchers to comprehend the strategies people use to estimate the portion size by understanding the memory structure.

Research Objectives

Dough development is a key step whenever consumers are baking or cooking products such as yeast bread or tortillas. However, questions on how to mix the ingredients and knead the dough arise, especially on naïve consumers. There is not clear information available about how experienced consumers form the dough and describe its readiness. Therefore, the objective of this study was to develop a recipe based on how experienced consumers prepare and describe a wheat dough for a yeast bread, and a corn dough for tortillas; as well as to validate the different styles of recipes built with naïve consumers who want to learn the preparation of a wheat or corn dough.

Personal interviews were conducted using the Think Aloud Technique to understand how consumers describe the process and techniques of making a dough and the description of ready doughs. Moreover, five styles of recipes were built using the consumers' terms and descriptions.

Each of the recipes were evaluated in a nationwide survey were naïve consumers/cooks, with the desire of learning, evaluated different aspects of each of the recipes.

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Chapter 2 - Development and validation of a recipe method for doughs.

Abstract

Recipes have a great impact on consumers' behavior at the kitchen; building a recipe requires understanding of the potential user. That is why, the objective of this study was to develop and evaluate different recipe styles for the preparation of doughs by understanding people's descriptions of these. Two qualitative studies were performed (43 wheat and 50 corn dough preparers). During interviews, participants described the preparation process of the doughs using the Think Aloud technique. The ready doughs were described as not sticky, soft and pliable. Based on these descriptions, five recipes were created: not detailed, very detailed, detailed, paragraph form and with images. Recipes were validated in two online surveys (total n=600) where respondents evaluated the easiness, likeability, likelihood of using, helpfulness of the format, and amount of information. Overall, respondents considered the recipe with images as easier and more helpful. The very detailed recipe was considered more difficult, less helpful and was liked less than the other recipes. Understanding and identifying the words and techniques people use represent a good way to communicate how to prepare a food product, these observations can be translated into a recipe. However, the format in which the recipe is presented might be a more important factor considered by users when following recipes.

Introduction

Currently, families in the United States are more likely to eat at home, which has increased the use of recipes as a guide for cooking preparations. A survey from 2012 shows that 67% of home cooks used a recipe at least once in the last month (The NPD Group, 2012). This is especially influenced by Millennials who are using recipes for cooking at least once a week (Mintel, 2011).

Recipes can be defined as a set of directions that tell the user how to cook and prepare a food product. They are usually derived from traditions where cooking was learned by imitation. Recipes frequently have an ingredients list followed by cooking directions (Brunosson et al., 2014). However, there are some other key factors users considered important in a recipe, such as cooking temperatures, possible variables during the process, and expected outcomes (Brunosson et al., 2014; Granberg et al., 2017; Levis et al., 1996).

Recipes have a great impact on consumers' behavior at the kitchen. Godwin et al (2016) research determined that users have better food safety behaviors when recipes have food safety instructions in them compared to occasions when recipes do not have these type of instructions. Therefore, providing accurate information on how to prepare a product is crucial for consumers' understanding, satisfaction, and safety (Levis et al., 1996).

Building a recipe requires food science knowledge, as well as understanding of the potential user. The writer needs to be able to communicate to the reader or preparer the best way to make the food product. Directions should be easy to read and follow, should be written in layman's terms, and should not be cluttered (Landers, 2003; Shapiro, 1990). Bielunski (1994) directed a survey to explore what consumers want in recipes. Respondents mentioned they like recipes that seem easy to prepare; the easiness of the recipe was evaluated based on the number of ingredients, preparation time, and overall readability.

There are multiple formats in which a recipe can be written. Using focus groups, Levis et al. (1996) studied three different recipe styles: paragraph-form, numbered step-by-step, and a graphical/text format. Results showed that consumers preferred the step-by-step format since it was easy to read and follow. The graphical/text format was also liked because it was eye-catching, easy to follow and gave them confidence. Bielunski (1994) studied people's impressions towards paragraph form recipes (single and multiple paragraphs) and numbered and bulleted recipes. Participants mentioned they liked recipes where the ingredients were broken out and where preparation steps were numbered or bulleted. Interviewees also preferred recipes with short and concise directions that were still specific (Bielunski, 1994; Reed & Schuster, 2002).

The objective of this study was to develop and evaluate different recipe styles (not detailed, very detailed, detailed, paragraph form, and with images) for the preparation of doughs by understanding how people at home make and describe these products.

Materials and Methods

Qualitative study

This study has the approval of the International Review Board of Kansas State University.

Subjects recruiting

Two observational studies to determine how consumers prepare and describe wheat and corn doughs were conducted through personal interviews in two locations: Manhattan, KS, USA, (43 wheat dough preparers) and Guadalupe, San Jose, Costa Rica (50 corn dough preparers).

To be part of the studies, preparers had to be over 18 years old and not professional bakers or cooks. For the wheat dough study, participants were bakers of yeast breads or pizza from scratch. For the corn dough study, participants were cooks of tortillas, empanadas or bizcochos (type of crunchy corn-based ring made from corn dough) from scratch. Participants were told that

the study required them to prepare a dough from scratch while they described their experience to a researcher. All the participants agreed to do it.

For the wheat dough study, participants were recruited via RedJade Sensory Software using the consumer database of the Center for Sensory Analysis and Consumer Behavior from Kansas State University. Therefore, most of the participants were from Manhattan, KS. In Costa Rica, participants were recruited through an external marketing agency; screeners were applied in person to consumers in their database. Most of the participants were from regions close to Guadalupe, Costa Rica. The recruiting and interviews in Costa Rica were done in Spanish, information collected was later translated.

Participants' demographics

Table 2.1 shows the demographic information of preparers who participated in the studies.

Table 2.1. Demographic information of 43 wheat dough preparers and 50 corn dough preparers who participated in the studies.

Demographics	Wheat study (%)	Corn study (%)
Gender		
Female	79	100
Male	21	0
Age (years)		
18-24	5	6
25-44	42	46
45-64	53	44
65 or older	0	4

Dough preparation

Home-style kitchens were used in each of the locations. Participants in Manhattan were asked to prepare a wheat dough for a yeast bread, and in Costa Rica, a corn dough for tortillas. A variety of equipment was supplied. This included bowls, spoons, spatulas, and measuring spoons

and cups; mixers were not provided. Wheat dough preparers were given commercial all-purpose wheat flour, salt, instant yeast, vegetable oil and water; corn dough preparers were given yellow corn flour, salt, and water. Each of the ingredients were measured prior and post sessions to determine the amount of ingredients used by the consumers. Table 2.2 shows the amount of each of the ingredients given to consumers.

Table 2.2. Amount of ingredients given to dough preparers.

Ingredient	Wheat (g)	Corn (g)
<i>Flour</i>	500	400
<i>Water</i>	1000	500
<i>Salt</i>	70	50
<i>Instant yeast</i>	14 (approx., equivalent to 2 packets)	NA
<i>Vegetable oil</i>	112	NA

A basic, not detailed, recipe was given to participants as a guidance, however, they were told they did not need to follow it since they were encouraged to prepare the dough as they usually do at home.

In order to obtain descriptions of the doughs and the technique used by participants, the Think Aloud technique (Bruun & Stage, 2015) was used. Prior to dough preparation, participants were instructed to think aloud while preparing the dough. Each participant verbally described his or her strategy and process for deciding how to make the dough. They verbalized how they decided one step was ready before moving to the next step.

The dough preparation sessions were video recorded. Moderators took pictures of the ready corn and wheat doughs.

Post session interview

A brief interview was done to participants after the completion of the dough preparation. Participants were asked how similar was the dough preparation during the sessions to the way they would do it at their own kitchens. Then they were asked to describe, just using words, how they decided the mixing stage (in both studies) and the kneading stage (just in the wheat study) were done.

Moderators

Moderators participated in a training session and a practice session; seven assessors moderated the wheat dough preparation sessions. In the corn dough preparation, two moderators guided the sessions. A detailed protocol was provided to each of the moderators, as well as an observational worksheet.

Recipes validation

Based on descriptions given by consumers during the dough preparation sessions, five different styles of recipes for each type of dough were developed. The styles studied were:

1. Not detailed recipe: same as the one given to experienced consumers during the dough preparation sessions; written in a step-by-step format.
2. Very detailed recipe: recipe that included a complete and exhaustive description of the preparation of the dough and the ready dough; written in a step-by-step format
3. Detailed recipe: recipe that included details, but not as much as the very detailed recipe. This recipe was less exhaustive than the very detailed one and it was written in a step-by-step format.
4. Paragraph form; based on the detailed recipe, the process was described in paragraphs.

5. Images; also based on the detailed recipe. The process was written using pictures taken from the dough preparation sessions and some captions to describe each of the steps.

All the recipes included the yield of the recipe, an initial setup that instructed readers to wash their hands, and baking/cooking steps. These steps were presented the same way in all the recipes evaluated. The recipes can be found on Appendix G.

Online survey

An online survey to collect consumers' impressions of each of the recipes was conducted using Qualtrics software (Qualtrics, Provo, UT, USA) licensed for Kansas State University (Appendix D). The survey was applied all over the United States. The questionnaire included three sections; the first section was the screener, which respondents had to pass in order to participate in the survey. The second section was the recipes validation, which recorded respondents' impressions of each of the recipes. For each recipe, respondents were asked to rate the easiness of it, how likely they were to use the recipes at home, how much they liked the instructions, and how helpful was the format of the recipe. They also answered Check-all-that-Apply (CATA) questions regarding what they liked and what they did not like of each recipe. The last section was a demographics questionnaire, where consumers were asked their gender, age range, and ethnicity. In this section, they were also asked the reasons why they do not prepare corn tortillas or yeast breads more often; their main source of information for recipes; how often do they read and follow recipes; and how often do they follow the ingredients, cooking temperatures, cooking and preparation times, assembly directions, and mixing directions in a recipe.

Participants

To participate respondents needed to be over 18 years old and not professional bakers or cooks. They had to rate their own cooking abilities as novice, basic or average. They also had to answer how often they had prepared corn tortillas or yeast breads (not using a bread machine) from

scratch: never or once or twice in the past five years. Participants needed to be interested in learning how to make corn tortillas or yeast breads. In each of the surveys, 300 respondents participated.

Table 2.3 shows the demographics of participants in the study.

Table 2.3. Demographic information of participants of the online surveys (per study, n=300).

Demographics	Wheat study (%)	Corn study (%)
Gender		
Female	81	79
Male	19	21
Age (years)		
18-24	7	8
25-34	12	14
35-44	17	13
45-54	19	19
55-64	21	24
65 or older	24	22
Ethnicity		
White, not of Hispanic origin	84	84
Black, not of Hispanic origin	7	8
Asian or Pacific Islander	4	2
American Indian or Alaskan	1	1
Native Hispanic	3	2
Prefer not to answer	2	3

Data analysis

Qualitative study

A transcript of each of the sessions was built using the video recordings and the written notes on the observational worksheets. Transcripts were edited to get the information needed to build the recipes: amount of ingredients (g), measurement technique (household/volume, weight, a combination of both, or neither), and water temperature (°C). For the mixing and kneading, the following information was collected: time, utensils used, technique applied, and attributes used to

describe the dough. For the attributes and the techniques, common or similar terms were grouped together into a category. Participants mentioned attributes reported three or more times.

Online survey

In each study, the data of the easiness of the recipes, how likely participants were to use the recipes at home, how they rated the amount of information, how much they liked the instructions, and how helpful they found the format of the recipes, was analyzed using analysis of variance (ANOVA). Significant differences ($p \leq 0.05$) across recipes were evaluated using Tukey's HSD test. Pearson's correlation coefficient was used as an exploratory tool to determine significant associations among responses. Respondents were clustered using K-means based on the liking scores of the instructions to analyze the differences/similarities among groups.

CATA questions were analyzed using Cochran's Q tests. To illustrate the relationship between recipes and the parameters asked, a correspondence analysis (CA) was performed considering chi-square distances; based on this, a symmetric plot was built.

All the analyses were done using XLSTAT-Sensory, sensory analysis statistical tools in Excel (Version 19.4 2017.06.19, Addinsoft, New York, New York, USA).

Results and Discussion

Preparation process

Measurement of ingredients

Measurement techniques used by consumers when preparing the doughs are shown on Table 2.4. During the wheat study 86% of preparers used the household/volume method, while 18% of corn preparers used this technique. Weight was the technique used the least in both studies, with 5% in the wheat study and 2% in the corn study. Recipes were built using household/volume measures since it was the most common technique used by preparers. This technique is not as accurate as weighing ingredients, especially for solid food products like flour. However, it is commonly preferred during cooking since it is faster, and accuracy might not be as important (Gisslen, 2011).

Not measuring ingredients was usual among participants; 84% of wheat and 88% of the corn dough preparers did not measure at least one of the ingredients. Flour was the main ingredient not measured: 74% of wheat dough preparers and 80% of corn dough preparers did not measure the amount added. During the corn dough preparation, most of the preparers did not measure any of the ingredients. Not measuring ingredients is related to the cooking abilities of the preparers and their knowledge of the ingredients. Participants were not asked to rate their own cooking skills, however 84% of corn dough preparers mentioned they prepare corn dough products daily or weekly. Previous studies show that high frequency of food preparation is an indicative of high cooking abilities (Frans, 2017; Ternier, 2010).

Water was not measured by 82% of corn dough preparers, 9% of wheat dough preparers did not measure the water in contrast to 88% of corn dough prepares. The salt was not measured by 82% of the corn dough preparers, but it was measured by all of the wheat dough preparers.

Table 2.4. Measurement techniques mostly used by 43 wheat dough preparers and 50 corn dough preparers during the dough preparation sessions.

	Wheat (%)	Corn (%)
Measurement technique		
Household/Volume	86	18
Weight	5	2
Household/Volume and Weight	9	2
Not measured ingredients	84	88
Did not measure flour during mixing	7	80
Did not measure flour during kneading	67	NA
Did not measure the water	9	88
Did not measure oil as ingredient	40	NA
Did not measure oil to the bowl	12	NA
Did not measure the salt	NA	82

Table 2.5 shows the amount of ingredients used by dough preparers. During the wheat dough study, consumers used an average of 326 g. Water was used between 191 g and 378 g with an average of 251 g. The averages for both, salt and yeast, were 7 g. The amount of oil was between 0 g and 112 g. For the corn study preparers used between 43 g and 500 g of corn flour with an average of 158 g; the amount of water was in average of 229 g. The salt ranged between 0 g and 52 g with an average of 6 g. Since most of corn participants did not measure the ingredients, they were asked the yield from the dough prepared, which in average was 3 tortillas.

Recipes were built based on the average amount of each ingredient used by dough preparers. In both studies, the amount of water used by preparers was more than the amount used in other studies. For wheat dough, AACC (1999) method suggests 47% (bakery percentage) of water while Curic et al. (2008) suggests 58%. Contreras-Jimenez et al. (2014) reported a water absorption for corn flour between 80% and 111%. However, the amount added varied depending on the type of flour and the user preferences, among other things.

Table 2.5. Amount of each of the ingredients (g) used by 43 wheat dough preparers and 50 corn dough preparers during the dough preparation sessions.

Ingredient	Wheat dough			Corn dough		
	Average* (g)	Minimum (g)	Maximum (g)	Average* (g)	Minimum (g)	Maximum (g)
Flour	326	193	426	158	43	500
Water	251	191	378	229	52	649
Salt	7	2	36	6	0	52
Yeast	8	4.5	14	NA	NA	NA
Oil	25	0	112	NA	NA	NA

*Amounts used for the recipes

Regarding the temperature of the water, 49% of wheat dough preparers used warm water between 30°C and 66 °C, with an average of 44°C. In the corn dough preparation, 22% of preparers used water between 32°C and 71 °C, for an average of 46 °C. Even when not all the preparers used warm water, literature suggests that the temperature of the dough is a key factor to ensure uniform processing conditions and the final product quality. For bread making, Cauvain and Young (2007) recommend a temperature of 30°C; commercial brands packages recommend a temperature between 49°C and 55°C for instant yeast. During yeast bread preparation warm water guarantees better conditions for the yeast development (Cauvain & Young, 2007). For the preparation of tortillas less information is available, however, warm temperature improves dough performance in next stages (like sheeting or forming). Due to the importance of the temperature during dough preparation, recipes were written using warm water even when most of the consumers used room temperature water.

Mixing and kneading

When preparing the doughs, 33 of the 43 wheat preparers and 15 of 50 the corn dough preparers mixed the dry ingredients before adding the water. During the wheat dough study, preparers took between 6 seconds and 2.75 minutes with an average of 33 seconds. The corn dough

preparers took between 5 seconds and 1.25 minutes, with an average of 21 seconds. Mixing wet and dry ingredients took between 53 seconds and 9.15 minutes for wheat dough preparers, for an average of 3.78 minutes. Corn dough preparers took between 44 s and 5.75 min for an average of 2.7 min. The kneading stage, which took place only during the wheat dough preparation, took between 57 s and 10.53 min for an average time of 4.55 min. Average times were included in the recipes for the main stages. Previous studies show that food preparers like the addition of times in recipes (Bielunski, 1994; Brunosson et al., 2014).

Table 2.6 shows the utensils used by dough preparers. During the wheat dough mixing stage, spoons (wooden and metal) were the most commonly used; 63% of preparers used them while mixing the dry ingredients and 72% while mixing wet and dry ingredients. Preparers also used their hands to mix ingredients, 5% used them when mixing dry ingredients, 7% when mixing dry and wet ingredients and all of them during kneading. The use of hands as a utensil was more common in the corn study, where 96% of preparers used them to mix the wet and dry ingredients. Metal spoons were also used by 14% of people while mixing dry ingredients, and 16% while mixing wet and dry ingredients. Spoons represent one of the most common utensils used by people at their kitchens as reported by Wang and Worsley (2014). The use of the hands might be related to the easiness to prepare the products by direct contact with them, also, as results will show, the main criteria to decide if the dough is ready is through the texture perceived with the hands.

Table 2.6. Utensils used by 43 wheat dough preparers and 50 corn dough preparers in each of the mixing stages during the dough preparation sessions.

Utensil	Wheat (%)		Corn (%)	
	Dry ingredients	All (wet and dry) ingredients	Dry ingredients	All (wet and dry) ingredients
<i>Wooden spoon</i>	44	65	0	0
<i>Metal spoon</i>	19	7	14	16
<i>Rubber spatula</i>	7	9	0	0
<i>Whisk</i>	2	0	0	0
<i>Fork</i>	0	0	0	2
<i>Hands</i>	5	7	16	96
<i>More than one utensil</i>	0	11	0	16

The techniques that preparers used to mix the ingredients and knead the dough are shown on Table 2.7. *Circular motions* and *from the edges to the center* were the most common techniques used when mixing the dry ingredients in both studies. During the mixing of all the ingredients, for both doughs, *mixing all the ingredients together*, *circles/ stirring*, *scraping the bowl* and *adding water a little bit at a time* were the most common techniques used. *Pressing*, *pushing* or *squeezing* the dough was also a common technique when preparing the corn dough, as well as during the kneading of the wheat dough. Other techniques commonly mentioned by preparers during kneading were *folding the dough* and *stirring*.

The main goal of the mixing and kneading stages is to input energy to the mix. This energy input helps the gluten development, incorporation of air, and formation of an extensible dough. In both doughs, the energy contribution helps obtain a dough from the mixture of all the ingredients (Tandazo, 2013). Pressing, pushing, stirring and folding are common techniques for these stages according to literature (International Food Information Service, 2009).

Table 2.7. Mixing and kneading techniques used by 43 wheat dough preparers and 50 corn dough preparers during the dough preparation sessions.

Technique	Wheat (frequency)			Corn (frequency)	
	Dry ingredients	All (wet and dry) ingredients	Kneading	Dry ingredients	All (wet and dry) ingredients
<i>Stirring/Circular motions</i>	25	31	NA	12	31
<i>From the edges to the center</i>	9	4	NA	1	5
<i>Incorporating all together</i>	8	27	NA	NA	36
<i>Scraping the bowl</i>	2	25	NA	4	15
<i>Folding the mix or the dough</i>	5	12	36	2	19
<i>Well in the center</i>	13	NA	NA	1	NA
<i>Adding water, a little bit at a time</i>	NA	31	NA	NA	17
<i>Breaking lumps</i>	NA	7	NA	NA	8
<i>Adding flour when sticky/wet</i>	NA	12	23	NA	6
<i>Pressing/Pushing/Squeezing the dough</i>	NA	23	43	NA	50
<i>Timewise</i>	NA	2	5	NA	NA
<i>Rolling the dough</i>	NA	NA	12	NA	NA
<i>Quarter turn</i>	NA	NA	25	NA	NA
<i>Using the heel/palms of the hand</i>	NA	NA	19	NA	NA
<i>Flouring the surface</i>	NA	NA	38	NA	NA
<i>Too dry, needs more water</i>	NA	16	NA	NA	20

Description of a ready dough

Attributes given by preparers to describe the ready dough are presented on Table 2.8. *One ball, mixed in and homogeneous* were common attributes used to describe the doughs after mixing. This was expected since the main objective of mixing is to incorporate all the ingredients together, i.e. to homogenize them and get rid of lumps (Cauvain & Young, 2007; Tandazo, 2013). Similar

results were found to describe the mixing of the dry ingredients; participants main attributes were *all mixed in*, this included the *yeast being evenly spread*.

Sticky was one of the main attributes mentioned after mixing the wheat dough, *elastic* was also common in this dough after kneading, and *not sticky* was mentioned in both studies to describe the ready doughs. Rheological studies show that before kneading dough is more sticky and wet, these characteristics decrease during kneading and other characteristics like cohesiveness and elasticity arise (Gajula, 2017; Rahimi, 2011). The adhesiveness of the dough is another textural parameter often measured in rheological studies; this relates to what preparers called stickiness (Bhattacharya et al., 2005).

Participants did not mention cohesiveness, a common term used in the instrumental texture analysis of doughs. Lawless and Heymann (2010) indicate that cohesiveness is a complex and very technical attribute which might be too specific for regular consumers with no further training or knowledge (Rahimi, 2011; Schiedt et al., 2013).

Most of the attributes mentioned by preparers in both doughs preparations relate to the texture of the dough, specifically to mechanical textural characteristics. These characteristics represent how the dough reacts to stress like pushing, pressing or stirring (Szczesniak, 1962). Results show how doughs are an example of a food product where texture is more important than flavor (Szczesniak, 1971). However, 35% of corn dough preparers still considered the saltiness as a key component to decide if the dough is ready or not, contrary to wheat dough preparers that did not taste the dough.

The descriptions obtained by this study can be compared to the study done in 1937 by David Katz. *Body*, a common attribute used to describe doughs in his study, was not a term used by participants in the current studies. However, Katz related other attributes to the *body* of doughs,

such as stickiness and elasticity, dough preparers in the present study did mention these attributes (Mark & Stewart, 1958; Szczesniak, 1990; Szczesniak, 2002).

A common term mentioned by consumers was *not too soft but not too hard*. Szczesniak (2002) points out this as one of the main limitations when studying texture, since there are no clear and stated boundaries between these attributes, firm and hard.

Table 2.8. Attributes and terms used by 43 wheat dough preparers and 50 corn dough preparers to describe a ready dough.

Attribute	Wheat (frequency)		Corn (frequency)
	Dough after mixing all the ingredients	Ready dough (after kneading)	Ready dough
<i>Sticky</i>	27	6	NA
<i>One ball/Does not fall apart</i>	25	NA	18
<i>Moist/Wet</i>	11	3	10
<i>Mixed in</i>	21	NA	12
<i>Pulls away from the sides of the bowl</i>	11	NA	NA
<i>Homogeneous/lump free</i>	10	9	20
<i>Hard to stir</i>	9	NA	NA
<i>Soft/Soft but not too soft</i>	7	19	17
<i>Not wet/Dry</i>	7	8	22
<i>Not-sticky</i>	4	30	39
<i>Elastic</i>	NA	32	NA
<i>Smooth</i>	NA	29	3
<i>Consistent</i>	NA	18	NA
<i>Pliable</i>	NA	16	16
<i>One-ball</i>	NA	14	7
<i>Not too hard/Firm</i>	NA	10	17
<i>Airy</i>	NA	10	NA
<i>Can handle with hand/workable</i>	NA	7	20
<i>Spongy</i>	NA	4	NA
<i>Rolls</i>	NA	3	NA
<i>Desired saltiness level</i>	NA	NA	35

Pictures of the dry ingredients after mixed and during the wheat dough preparation are shown in Figure 2.2. The wheat dough after mixing is shown in Figure 2.1 and the ready wheat dough is shown in Figure 2.. The ready corn dough after mixing is shown in Figure 2..



Figure 2.2. Pictures of dry ingredients mixed during the wheat dough preparation.



Figure 2.1. Pictures of dry and wet ingredients mixed during the wheat dough preparation.



Figure 2.3. Pictures of doughs after kneading during the wheat dough preparation.



Figure 2.4. Pictures of doughs after mixing during the corn dough preparation.

Recipe validation

The results of the Qualtrics surveys for the recipes are shown below. Figure 2.3 shows consumers' perceptions of the ease of the recipes. In both studies, most of the people considered the recipes with images easy, very easy or somewhat easy. The ANOVA showed that the scores were significantly higher for these recipes in both surveys. Levis et al. (1996) found similar results; in their study where participants considered recipes with images easy to read and follow. In other studies, the step-by-step format was also considered easy by evaluators (Bielunski, 1994; Reed & Schuster, 2002). The step-by-step format was the one used for the very detailed, detailed, and not detailed recipes in this research. However, the very detailed recipe was considered the most difficult in both studies. The not detailed recipe was the longest of the recipes in both surveys, this finding suggests that the format does not affect the perceived easiness of the recipe as much as the length of it. Previous studies suggest the overall readability and the length of the recipes influence how recipe users perceived the ease of recipes (Bielunski, 1994).

In the corn study, there were not significant differences between the very detailed and the paragraph format recipes. Levis et al. (1996) research found that participants did not consider the paragraph form recipe easy since it required them rereading more often than an image or step-by-step format.

Similar results were shown when consumers were asked how likely they were to use the recipes at home, Figure 2.4 shows these results. Respondents were significantly more likely to use the recipes with images, while the paragraph format and the very detailed recipes were the least likely to be used. Bielunski (1994) found that the perceived easiness of the recipe is a key factor that determines people's likelihood to use the recipes at home. In both studies, the not detailed recipe, which is the shortest one of the step-by-step recipes, was the second most likely to be used by respondents.

Figure 2.5 shows consumers' impressions towards the amount information in the recipes. The ANOVA shows that for both surveys, the respondents considered the very detailed recipe to have significantly more information than all the other recipes, while the not detailed recipe had significantly less. The detailed recipe and the image and paragraph format recipes were all written with the same base, but the paragraph format allows to present the information in more compacted or cluttered way, while the use of images allows to use less words. This explains why the detailed recipe was considered to have more information than the other two recipes mentioned. The not detailed recipe lacks of details and descriptions, the average results show that respondents considered this recipe to have "far too little/too little" information. As mentioned, shorter recipes are usually perceived as easier for participants. However, the recipe with images, considered the easiest one for participants, was not rated as "far too little/too little" as much as the not detailed recipe (Bielunski, 1994; Brunosson et al., 2014).

For all the recipes in both surveys, more than 50% of participants considered the amount of information as "neither too much nor too little." The percentage was even higher in the recipe with images (close to a 90% on both surveys), and presented the lowest value in the very detailed recipe (54% in the wheat study, and 58% in the corn study). These results make the average values

very close to each other, ranging from 2.8% to 3.6%. However, a group of respondents considered the amount of information in some recipes “too little”, especially in the not detailed recipe, or “too much”, like in the very detailed recipe. These observations influence the averages reported and allow getting statistical differences among recipes in both studies.

Respondents’ likeability towards the instructions are shown in Figure 2.6. The recipe with images was the one liked the most by respondents, and it was the only recipe where most of the respondents mentioned that they liked it very much. In both studies, the very detailed recipe was the one liked the least; however, in the corn study it did not show statistical differences with the paragraph-form recipe. In Levis et al. (1996) study, participants did not like the paragraph format because it required rereading more often compared to a step-by-step recipe or a recipe with images. They had to read the entire paragraph before cooking, and it was easy to miss some parts of the recipe.

In previous surveys and studies, recipe users indicated they liked specific recipes that tell them what to do with a vocabulary easy to understand by the naïve cooks (Bielunski, 1994; Norrick, 1983). The present study shows that, even when consumers want specific details and further explanations of some techniques, they do not like and do not want to use long, very detailed recipes since they are considered difficult.

Consumers found the recipe with images as the most helpful, as shown on Figure 2.7. As mentioned, this recipe was considered the easiest one, and it was the recipe respondents liked the most and were more likely to use at home. Previous studies suggest that participants like this kind of recipes since they can pause on keywords and use the images as a guidance that help them picture the product (Bielunski, 1994; Klenova, 2010; Levis et al., 1996). The paragraph format was the one considered least helpful. The paragraph format recipe did not present a statistical

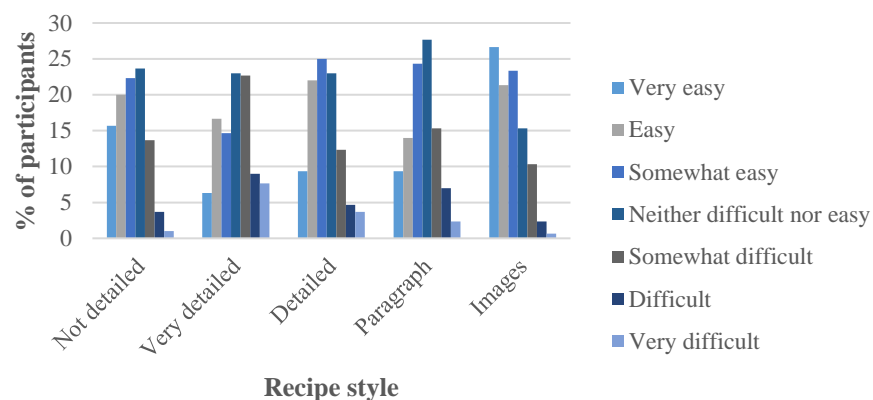
difference with the very detailed recipe in the wheat survey. The need of rereading the paragraph format recipe several times can be considered as not helpful by respondents (Levis et al, 1996).

The not detailed, the detailed, and the very detailed recipes were all written in the same format, step-by-step. Previous studies suggest this is one of the preferred formats by recipe users since it is easy to read and follow and participants could stop at keywords easier (Bielunski, 1994; Levis et al., 1996). In the wheat survey, there was a statistical difference among very detailed recipes and the other two step-by-step recipes. This might be an indication that consumers' evaluation of the helpfulness of the recipe is related to how much they liked the recipe rather than the actual format of it.

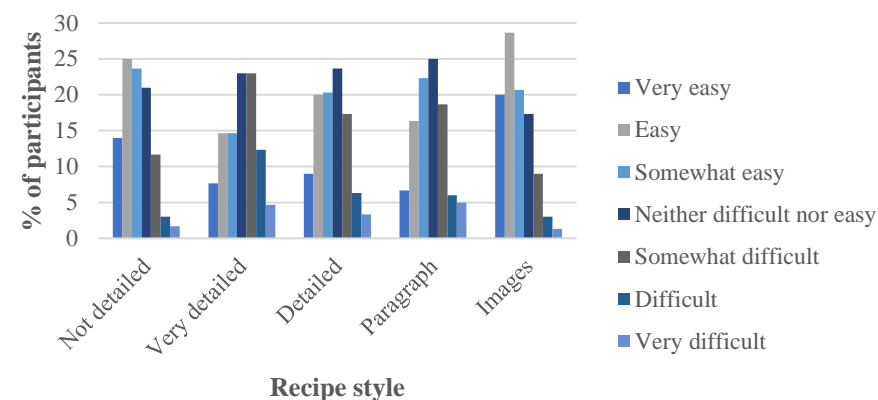
The results of the correlation test confirms the how answers are mostly based on how much respondents liked the instructions of the recipes. For both studies, the Pearson's correlation test showed high correlations ($p > 0.6$) between the likeability of the instructions and perceived helpfulness of the format, likeability of the instructions and ease of the recipes, likeability of the instructions and likelihood to use the recipes, and ease of the recipes and the likelihood to use them. Additionally, for the wheat survey, the format helpfulness and the likelihood to use the recipes was highly correlated. No additional correlations were found on the corn study.

Correlation analysis (Appendix F) confirms that respondents evaluated the helpfulness of the format, the likelihood to use the recipes, and the easiness of the recipes based on how much respondents liked the instructions on the recipes. The amount of information was the only parameter that did not present a correlation with at least one of the other items evaluated.

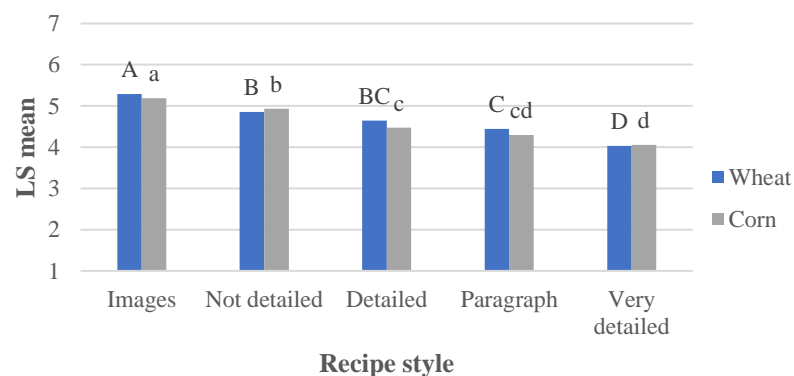
Easiness of the recipe



(a)



(b)

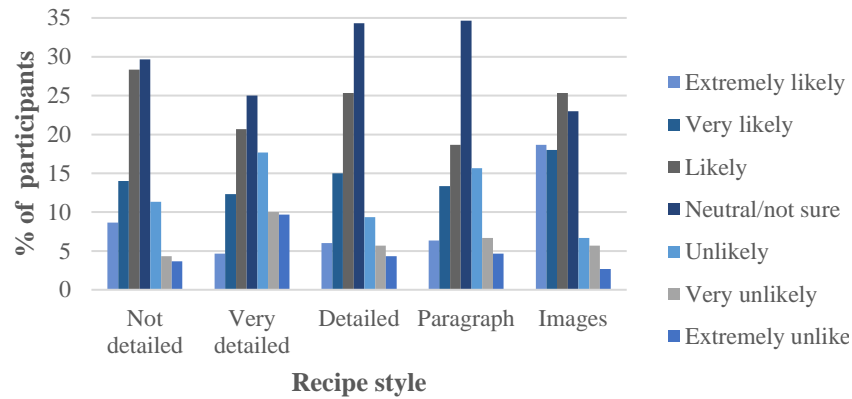


(c)

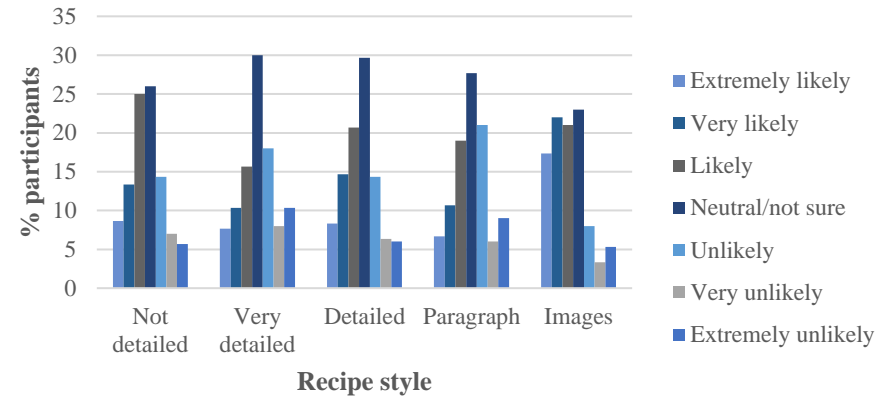
Figure 2.3. Easiness of the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.

Statistical comparisons are within wheat and corn recipes; different letters among studies represent significantly different means ($p < 0.05$).

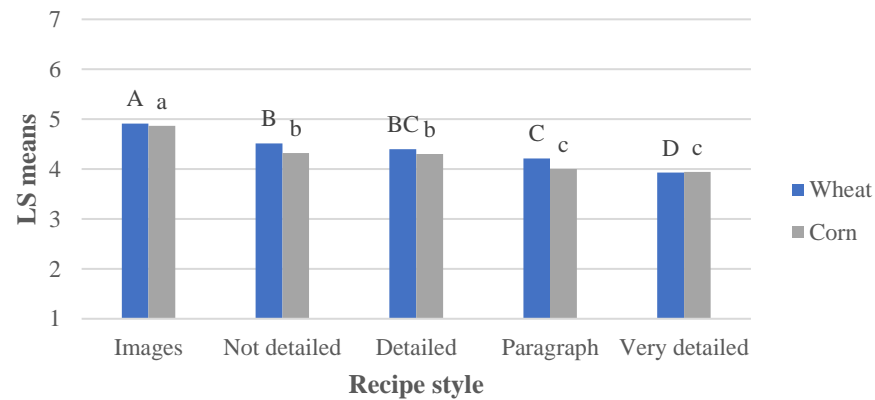
Likelihood to use the recipe at home



(a)



(b)

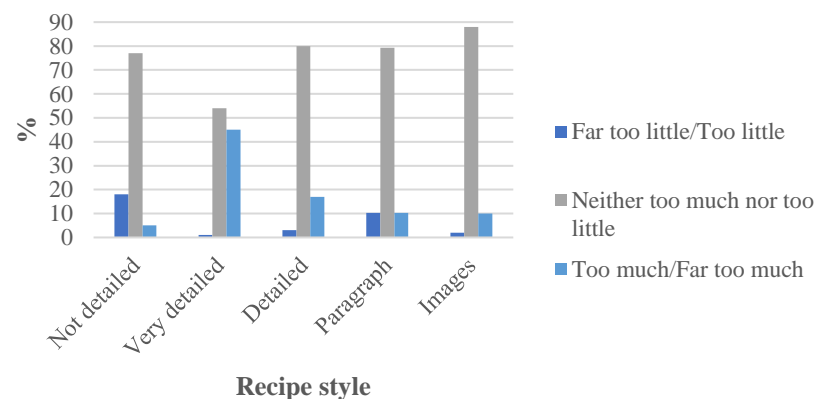


(c)

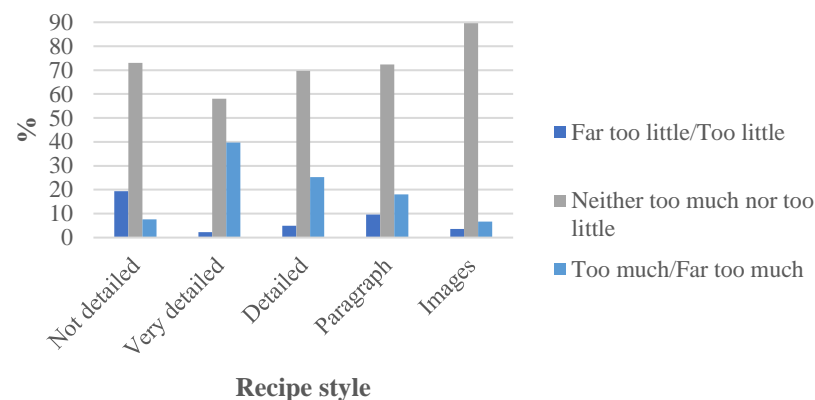
Figure 2.4. Likelihood to use the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.

Statistical comparisons are within wheat and corn recipes; different letters among studies represent significantly different means ($p < 0.05$).

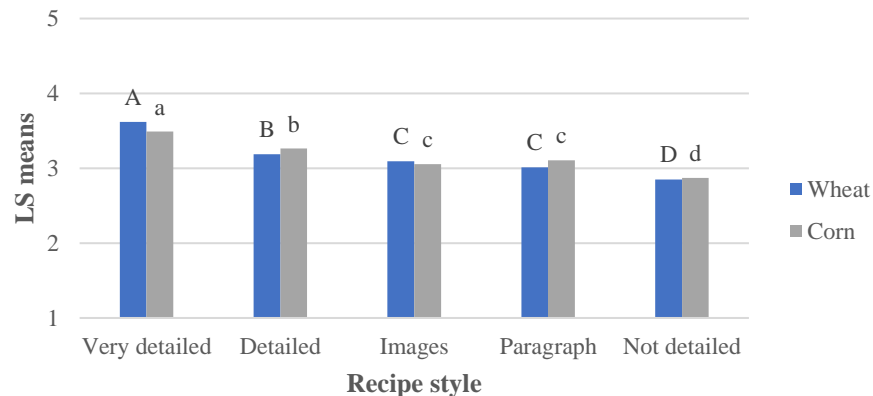
Perceived amount of information given in the recipe



(a)



(b)

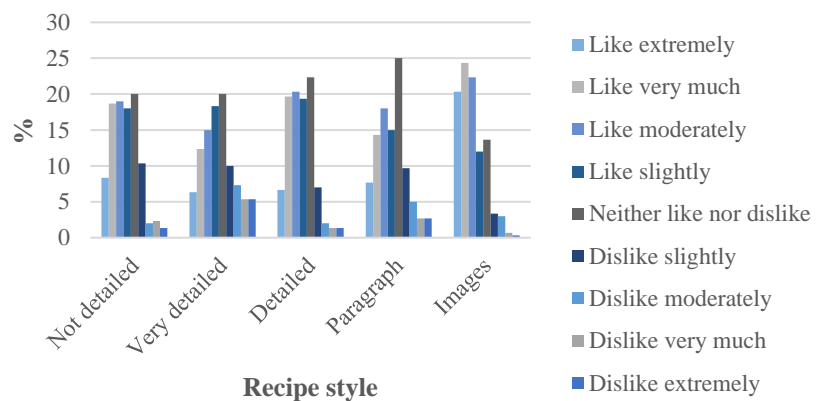


(c)

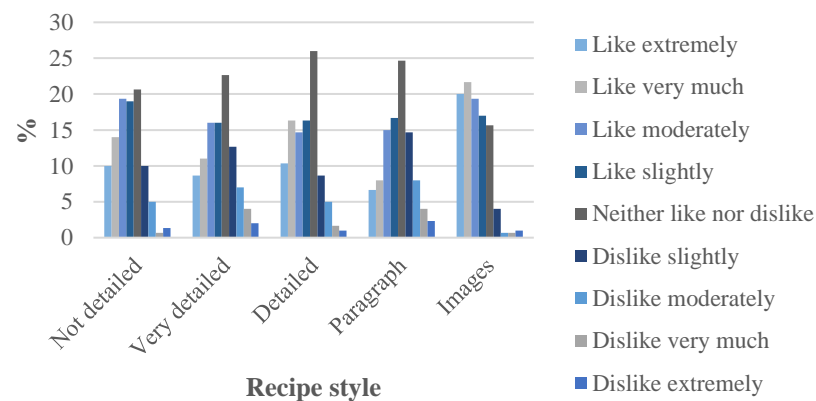
Figure 2.5. Perceived amount of information in the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.

Statistical comparisons are within wheat and corn recipes; different letters among studies represent significantly different means ($p < 0.05$).

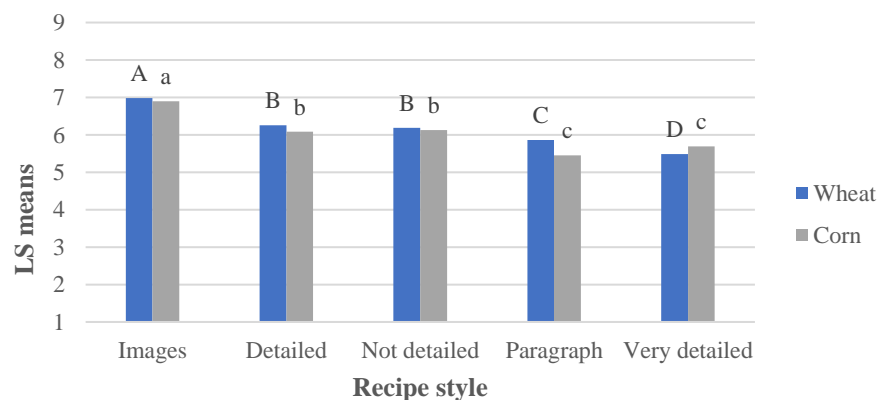
Likeability of the instructions



(a)



(b)

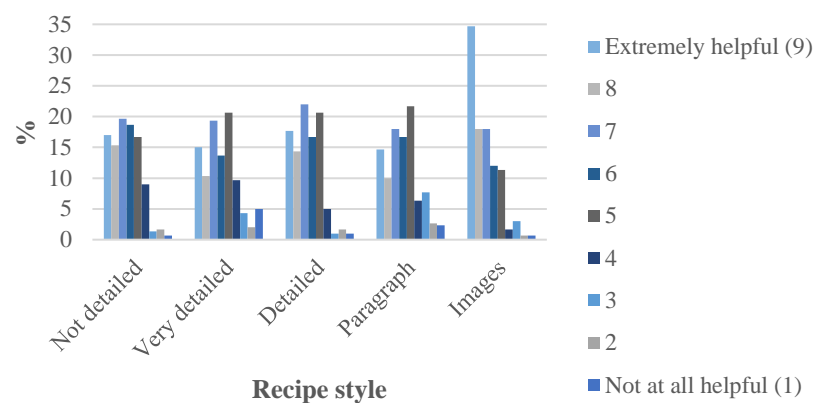


(c)

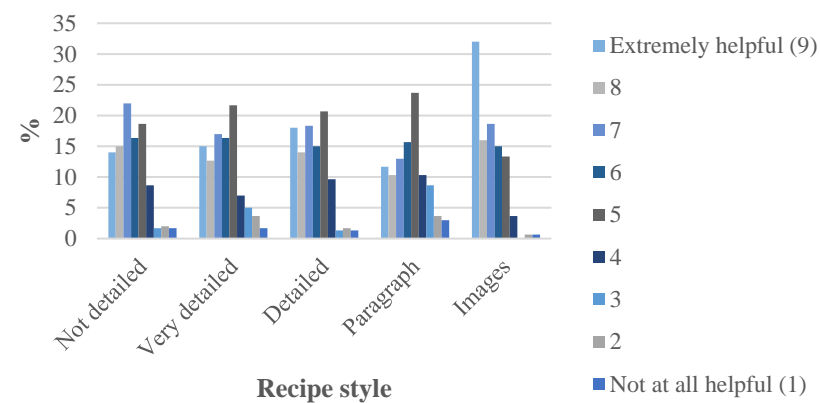
Figure 2.6. Likeability of the recipes presented to respondents (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA.

Statistical comparisons are within wheat and corn recipes; different letters among studies represent significantly different means ($p < 0.05$).

Helpfulness of the format



(a)



(b)

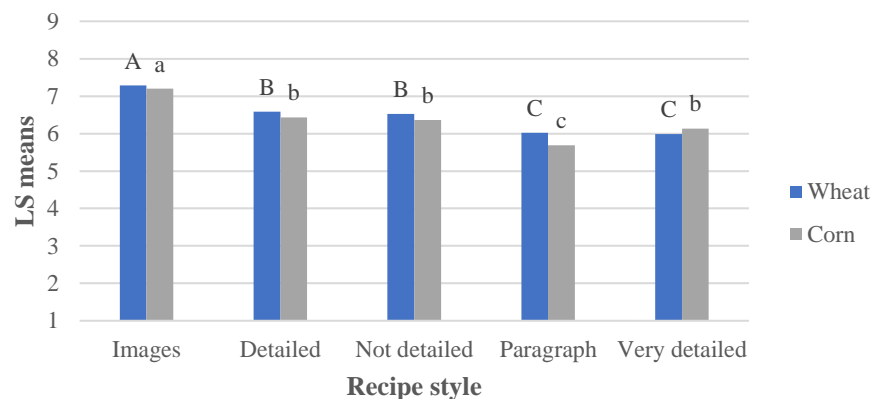


Figure 2.7. Helpfulness of the format of the recipes (per study, n=300), including (a) wheat study, (b) corn study, and (c) ANOVA. Statistical comparisons are within wheat and corn recipes; different letters among studies represent significantly different means ($p < 0.05$).

Cluster analysis

For both studies, the K-means procedures found two clusters; results are presented on Figure 2.8 and Figure 2.9. For the wheat study, cluster 1 had 169 observations, and cluster 2 had 131 observations. The ANOVA showed both clusters liked recipes with images the most, and the very detailed recipe the least. However, in Cluster 2 there were not significant differences between the very detailed recipe, the paragraph format recipe, and the detailed recipe. Overall, respondents in Cluster 2 show a higher likeability of the instructions compared to respondents in Cluster 1. On both clusters, about 80% were females with ages between 18 and 64.

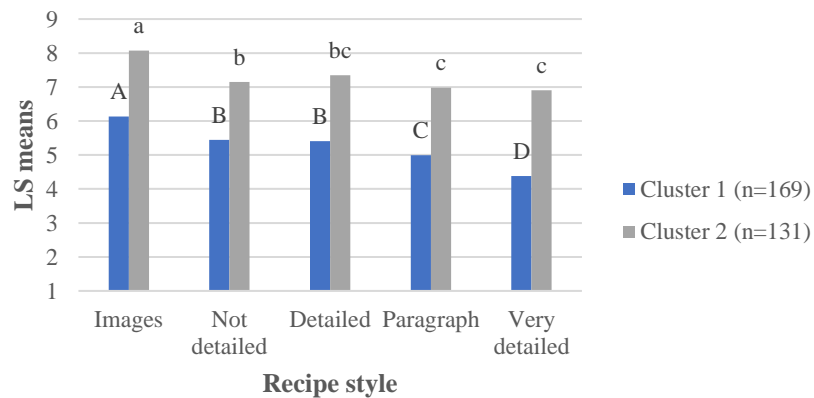


Figure 2.8. Likeability of recipe instructions per cluster for the wheat study. Different letters among clusters represent significantly different means ($p < 0.05$).

In the corn study, cluster 1 had 161 observations, while cluster 2 had 139 observations. In both clusters, the recipe with images had significantly higher likability of the instructions while the paragraph format recipe was the one with the lowest likeability scores. Nevertheless, in Cluster 1 there was not a statistical difference between the paragraph format recipe and the very detailed recipe. Results show that overall; respondents in Cluster 2 liked more the instructions of the recipes, compared to respondents in Cluster 1. Respondents of both clusters were mostly females (about 80%), with ages between 18 and 64.

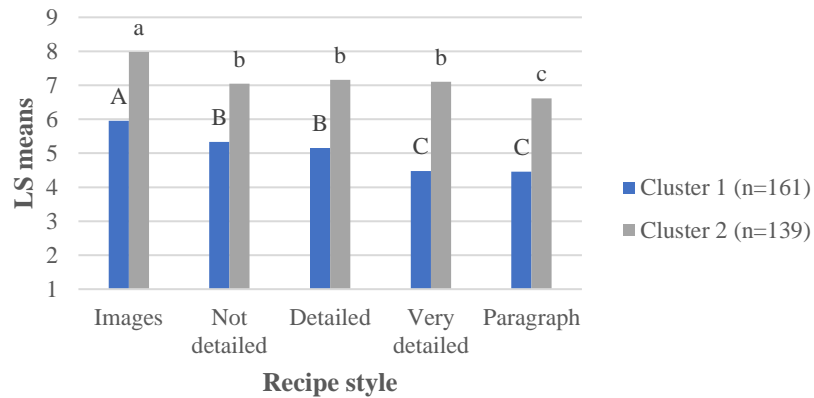


Figure 2.9. Likeability of recipe instructions per cluster for the corn study.

Different letters among clusters represent significantly different means ($p < 0.05$).

Liking and disliking factors in each recipe

Figure 2.10 and Figure 2.11 show what participants liked in each recipe, while Figure 2.12 and Figure 2.13 show what respondents did not like. Based on these plots, participants found some differences among recipes in terms of what they liked and what they did not like.

As seen on the plots for both surveys, participants liked the presence of images (K) on the recipes that had them, that the detailed and very detailed recipes were very detailed (P), and that the not detailed recipe was not very detailed (O). Nevertheless, these were disliking factors for other respondents.

Based on the plots, the X-axis shows two groups of respondents: people that like the presence of images (K), and people that like the absence of images (L). The amount of people that liked the presence of images was close to 75%, less than 10 % mentioned they liked the absence of them. The plots for the disliking factors show similar results; about 5% mentioned they disliked the presence of images while about 50% mentioned they disliked the absence of them. Based on the data collected, even when some people disliked the presence of images, these represent a very small group. These results confirm that the presence of images is an important factor on the evaluation of these recipes.

The Y-axis shows that some respondents liked the lack of details (O) in the not detailed recipe, while others liked that the detailed and very detailed recipes were very detailed (P). The disliking plots show similar results when participants answered what they did not like of the recipes: a group disliked the presence of details on the more detailed recipes, while another group disliked the absence of these in the less detailed recipes. Previous research mentions that recipe users like specific and detailed recipes. However, these results show there is a group of people that do not like the presence of details (Reed & Schuster, 2002).

As mentioned before, the not detailed recipe is the same recipe given to dough preparers. During the dough preparation study, some of the participants, mostly wheat preparers, mentioned that the recipe was not clear and not a good guide for the process. However, participants in the survey mentioned they liked it because it was not very detailed and because of the length of it. Additionally, it was considered as one of the easiest recipes and more likely to be used at home (after the recipes with images). This suggests that results might be different when users prepare food products using the recipes compared to what they answered on surveys just by reading the recipes.

Liking factors in each recipe

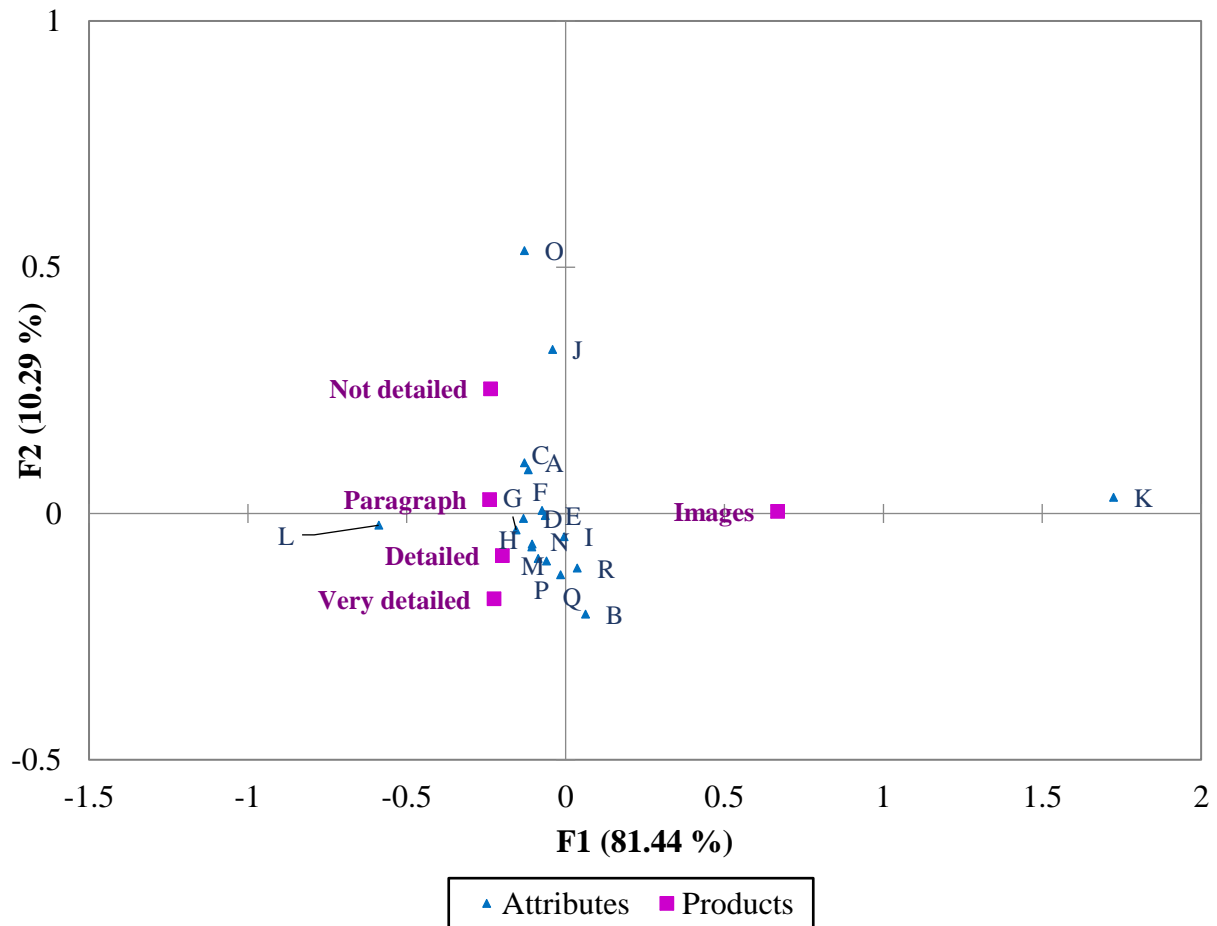


Figure 2.10. Correspondence analysis factor map representing 5 wheat recipes and 18 liking factors.

This factor map represents 91.72% of the total variance with factor 1 contributing to 81.44% and factor 2 covering 10.29% of the variance.

(A-That it uses household measurements, B-Utensils list, C-Ingredients list, D-The initial setup is described, E-The dough making procedure, F-Times in the initial setup, G-The process of mixing the dry ingredients, H-The process of mixing wet and dry ingredients, I-Times in the dough making procedure, J-The length of the recipe, K-That it has images, L-That it does not have images, M-Temperatures in the initial setup, N-Temperatures in the dough making procedure, O-That the recipe is not very detailed, P-That the recipe is very detailed, Q-The kneading process, R-The description of the ready dough)

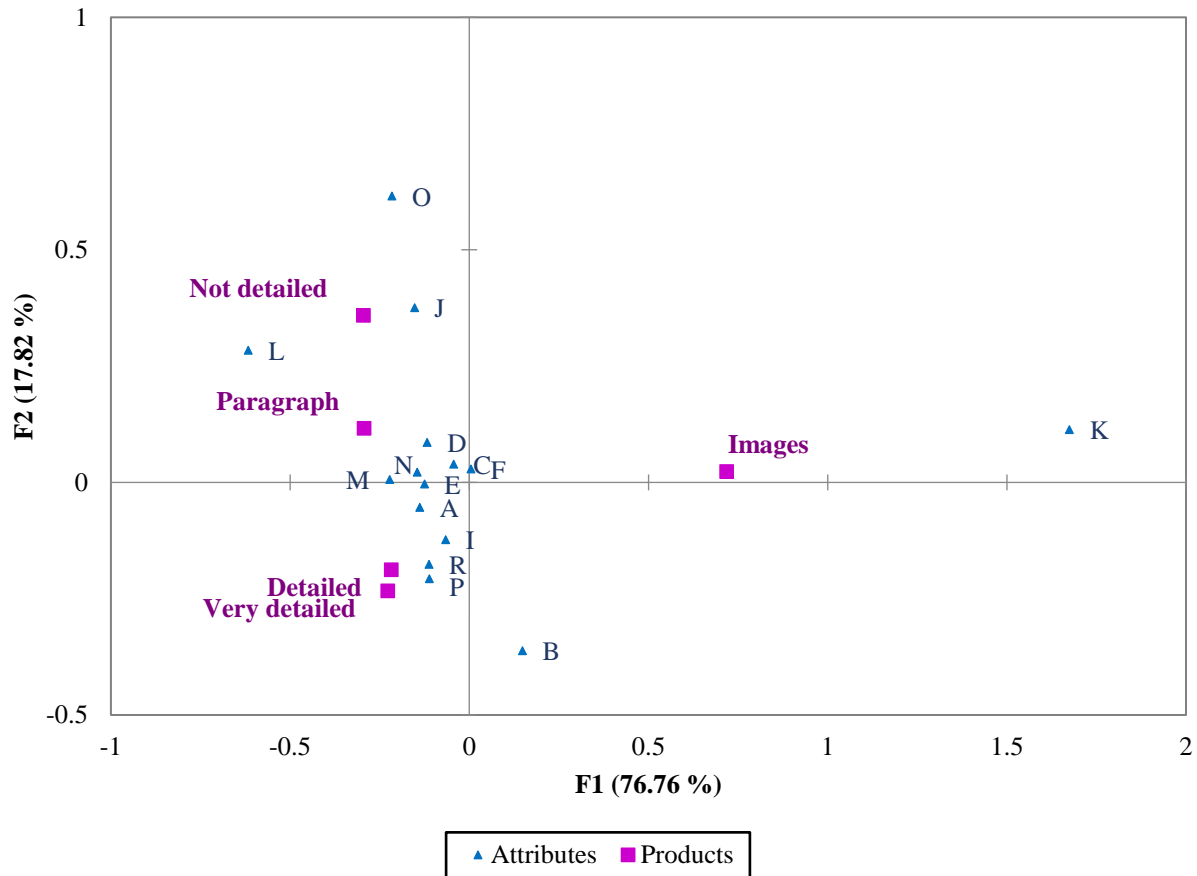


Figure 2.11. Correspondence analysis factor map representing 5 corn recipes and 15 liking factors.

This factor map represents 94.01% of the total variance with factor 1 contributing to 76.69% and factor 2 covering 17.32% of the variance.

(A-That it uses household measurements, B-Utensils list, C-Ingredients list, D-The initial setup is described, E-The dough making procedure, F-Times in the initial setup, I-Times in the dough making procedure, J-The length of the recipe, K-That it has images, L-That it does not have images, M-Temperatures in the initial setup, N-Temperatures in the dough making procedure, O-That the recipe is not very detailed, P-That the recipe is very detailed, R-The description of the ready dough)

Disliking factors in each recipe

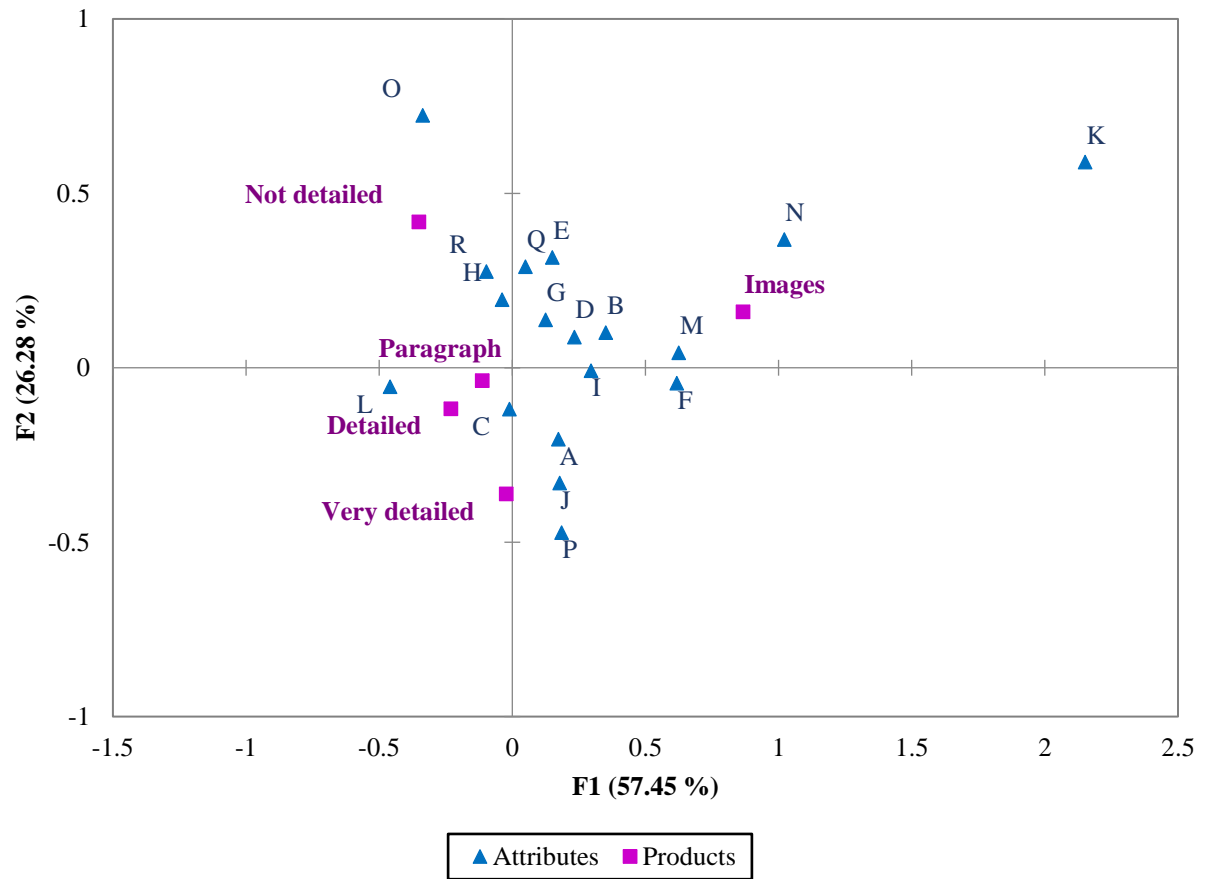


Figure 2.12. Correspondence analysis factor map representing 5 wheat recipes and 18 disliking factors.

This factor map represents 83.73% of the total variance with factor 1 contributing to 57.45% and factor 2 covering 26.28% of the variance.

(A-That it uses household measurements, B-Utensils list, C-Ingredients list, D-The initial setup is described, E-The dough making procedure, F-Times in the initial setup, I-Times in the dough making procedure, J-The length of the recipe, K-That it has images, L-That it does not have images, M-Temperatures in the initial setup, N-Temperatures in the dough making procedure, O-That the recipe is not very detailed, P-That the recipe is very detailed, R-The description of the ready dough)

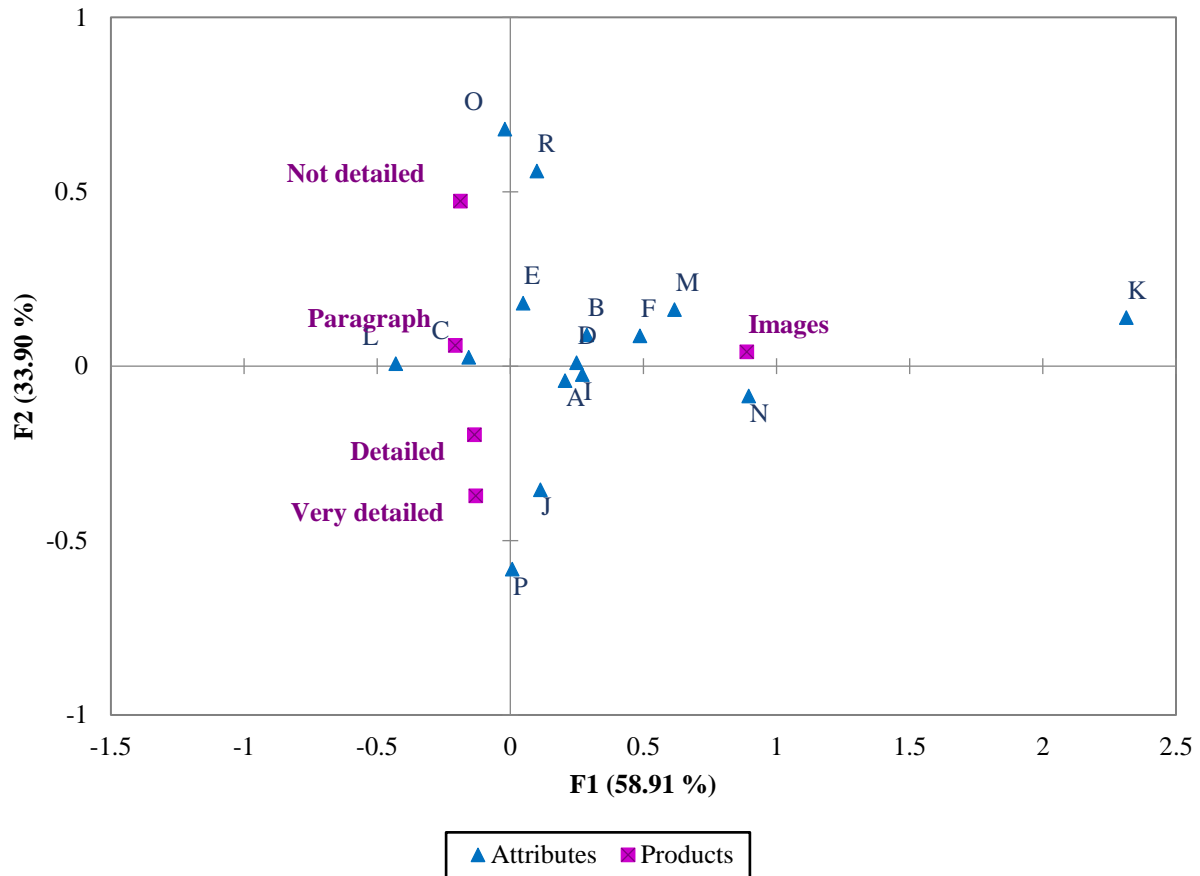


Figure 2.13. Figure 7. Correspondence analysis factor map representing 5 corn recipes and 15 disliking factors.

This factor map represents 92.80% of the total variance with factor 1 contributing to 58.91% and factor 2 covering 33.90% of the variance.

(A-That it uses household measurements, B-Utensils list, C-Ingredients list, D-The initial setup is described, E-The dough making procedure, G-Times in the initial setup, H-Times in the dough making procedure, J-The length of the recipe, K-That it has images, L-That it does not have images, M-Temperatures in the initial setup, N-Temperatures in the dough making procedure, P-That the recipe is very detailed. Q-That the recipe is not very detailed, R-The description of the ready dough)

Practical applications

This research retrieves consumers' terms and descriptions of doughs. Information collected helps to understand better a food product that has not been studied enough in the sensory field. The research includes descriptions of how regular home users manipulate doughs, important consumers' attributes on corn and wheat doughs that can be applicable to other kind of doughs, and consumers' overall experience when preparing doughs for yeast breads and tortillas. Results can be later applied for future development of trained sensory panels of doughs, quantitative research for consumers, or explanation of the preparation process to dough makers in industry at home (Muñoz et al. 1996; Lawless and Civille, 2013).

Participants on the surveys preferred the presence of images on the recipes presented. This information can be used on cooking or handling instructions on food packages to encourage and guide users on the preparation and use of the product. It also provides a guide on what is the best way to communicate to recipe users or food preparers.

Limitations

The corn dough preparations are not as common in the United States (except for Latin American communities), which is why the corn dough study was performed in Costa Rica. However, the recipes were evaluated in the United States after translation of the terms and descriptions. Cultural differences might exist between consumers' description and perception of sensory terms, especially due to the translation process (Antmann, Ares, Salvador, Varela, & Fiszman, 2011). In the same way, preparers in the United States described the preparation and the ready dough, so some of these descriptions might not be applied the same way in other parts of the world (Szczeniack & Kahn, 1970).

Furthermore, recipes were validated through a survey and not through a cooking exercise. Dough preparers had a different impression of the not detailed recipe compared to survey respondents. Results presented in the recipe validation might differ if the recipes were used in a cooking exercise.

Conclusions

Personal interviews where regular cooks prepare and describe the preparation of a food product represent a useful way of understanding and identifying the language and techniques people use. This information can be used for communicating how to prepare a food product through a recipe, to describe the final product, and to provide graphical and step-by-step information. However, the format in which the recipe is presented might be a more important factor evaluated by consumers when deciding to use a recipe or not. Users preferred recipes that have images since they considered them easier and more helpful. On the other hand, they do not like long, very detailed recipes since they are considered difficult and not helpful.

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Chapter 3 - Use of the Think Aloud Technique in Qualitative Sensory Analysis: A product preparation study

Abstract

Techniques applied in qualitative sensory analysis involve focus groups, in-depth interviews, and surveys. None of these allows to study motivations and actions of consumers. The objective of this research was to propose the use of the Think Aloud technique as a tool in sensory research for the study of consumers' actions and motivations. Wheat dough preparers (n=43) were recruited in Manhattan, KS. and corn dough preparers (n=50) in Guadalupe, Costa Rica. All participants were asked to prepare a dough while they verbalized their process (i.e. Think Aloud). Results showed that participants provided enough data by thinking aloud. It was observed that the use of the Think Aloud method allowed them to be aware of texture characteristics of the doughs. The Think Aloud technique is presented as a tool that can be used to collect consumers' terms that describe their actions and motivations without depending on memory and avoiding subjective interpretations.

Practical application

Different techniques have been applied in qualitative sensory research to study consumers' actions and motivations. Some of these techniques include focus groups, in depth interviews, surveys, and ethnographic studies. However, none of these techniques captures both, motivations and actions of consumers.

This research study explores the application of the Think Aloud technique in sensory analysis through a dough preparation exercise. Participants explained their decision-making process as well as the actions taken to obtain a product ready for baking or cooking while they prepared the dough. The intention of this study is to provide an initial guidance for the use of the

Think-Aloud technique in sensory analysis, as well as some recommendations for future applications.

Introduction

Sensory analysis is a science that evokes, analyzes, and interprets people's responses (Stone, Bleibaum, & Thomas, 2012). The study of actions and motivations is a key factor to understand these responses. To achieve this, qualitative sensory studies attempt to understand people's attitudes, perceptions, actions, motivations, and opinions. These techniques examine responses in uncontrolled, natural environments, rather than relying on instrumental or quantitative sensory measurements. Qualitative research techniques involve interviews or observational studies that are less structured than quantitative studies, but still allow deeper interaction and probing of attitudes and opinions (Lawless & Heymann, 2010).

Techniques so far used in qualitative sensory research to study actions and motivations include focus groups, one-to-one interviews, surveys, and naturalistic (also called ethnographic) observational studies. (Chambers & Smith, 1991; Jervis & Drake, 2014; Lawless & Heymann, 2010).

Focus groups are commonly used in qualitative sensory analysis. They usually involve discussions that requires participants to remember previous experiences to obtain their insights towards a specific topic (Chambers & Smith, 1991; Jervis & Drake, 2014). In sensory analysis, they have been used for the understanding of consumers' motivations, expectations, attitudes and descriptions (Cardinal, Flores, Contarini, & Guillermo, 2003; Lima, Della Lucia, Moulin, & Zacchi, 2015; Phan & Chambers, 2011). The information of actions or the understanding of how consumers make decisions while performing a process might not be obtained from these types of

group discussions. Similar limitations arise when consumers participate in one-on-one in depth interviews rather than group discussions (Chambers & Smith, 1991; Lawless & Heymann, 2010)

Surveys are a self-reported, qualitative approach, that can be used to study motivations, opinions, and perceptions (Phan & Chambers, 2016). However, they do not represent a good technique for understanding consumers' actions and behaviors. On the other hand, observational or ethnographic studies are an adequate technique to understand consumers' behaviors and actions, but they do not allow the understanding of motivations and opinions due the limited participation of the observer with the subject (Jervis & Drake, 2014).

The study of motivations and subsequent actions plays a key role on sensory analysis. Motivations help sensory scientists to understand the reasons underlying behaviors or actions. However, sensory research has not applied a method so far that captures both motivations and actions together. The Think-Aloud technique helps explore the consumers' inner speech, including their motivations. It allows the researcher to collect insights of the knowledge and motivations of the subjects, as well as their problem-solving methods and actions (Ericsson, 1993).

The Think-Aloud technique requires the user/consumer to talk aloud and vocalize while performing a task or solving a problem. The main advantage of the technique is that it produces direct information of the ongoing thinking process while the task is being performed, rather than requiring the moderator to ask questions about a past process (Benjafield, 1969; Charters, 2003; Morin et al., 2018; van Someren et al., 1994).

Computer science is one of the fields where the Think Aloud technique has been used the most (van Someren et al., 1994). This field uses this technique to understand the problems or issues people run into when using an application, program or website (Bruun & Stage, 2015). It has also been used in the medical field. Forsberg et al. (2014) studied the clinical reasoning of pediatric

nurses using virtual patients; the use of the technique allowed the researchers to get better understanding of the decision-making process nurses go through when evaluating a patients' case.

There have been few applications of the technique in consumer science. Senoo (2005) evaluated two cosmetic foaming cleansers by paired comparison using the Think Aloud technique. Using this technique in a preference test allowed the researcher to have straightforward data while consumers used each of the cleansers. Chambers et al. (2001) used the Think Aloud technique to determine the cognitive processes used by consumers to estimate portion sizes. The method allowed the researchers to comprehend the strategies people use to estimate the portion size by understanding the memory structure.

The aim of this study is to apply the Think-Aloud technique in a sensory research through a dough preparation study. Participants prepared a dough while describing the preparation process, their decision-making process and the subsequent actions. This research provides a guide, recommendations and limitations of this technique for its use on sensory analysis.

Materials and methods

Application of the Think Aloud Technique in a dough preparation study

Two Think Aloud studies to determine how consumers prepare and describe wheat and corn doughs were conducted through personal interviews in two locations: Manhattan, KS, USA, (43 wheat dough preparers) and Guadalupe, San Jose, Costa Rica (50 corn dough preparers). The sessions in Manhattan were done in English, the sessions in Guadalupe they were done in Spanish. Refer to Chapter 2 - for more details about participants and recruiting.

Home-style kitchens were used in each of the locations. Participants in Manhattan were asked to prepare a wheat dough, and in Costa Rica, a corn dough. In both locations, participants

were encouraged to prepare the doughs as they do at home. A basic, not detailed recipe was provided so that participants could use it as a guide.

Prior the dough preparation, participants were instructed to think aloud while preparing the dough. Each participant was encouraged to verbally describe his or her strategy and thinking process for deciding how to make the dough and how they decided one step was ready before moving to the next step. They were encouraged to say everything that came to their minds, regardless of how obvious it seemed for them.

To facilitate the application of the Think Aloud technique, and help respondents to understand the task, each respondent completed two warmup exercises using the Think Aloud technique prior the dough preparation. In the first exercise, participants had to arrange five cards of various shapes from smallest to largest. In the second exercise, they were given 10 cards total: five cards with a different figure or shape, and five cards with a different color. Participants needed to match a figure or shape with a color.

Participants were informed that the moderator would keep asking questions to make sure they kept thinking aloud and to make sure all the processes' descriptions were obtained. Moderators stated to participants that there were no wrong answers, and that the purpose of the session was to understand the process they usually use to prepare a dough.

Participants were observed during the warm up exercises and dough preparation. If they forgot to think aloud, moderators were instructed to remind them to think aloud asking non-suggestive questions, such as “What are you thinking?”, “How did you make your decision?”, “What strategy did you use to decide?”. All the dough preparation sessions were video recorded.

Post session interview

A brief interview was done to participants after the completion of the dough preparation. Participants were asked how similar the dough preparation sessions were to what they usually do at home. Finally, participants were asked to fill out a demographic questionnaire that included their gender, age range, frequency in which they prepare similar products, and flour-based products prepared in the last three months.

Moderators

Seven wheat dough moderators, and two corn dough moderators participated in a training session and a practice session. A detailed protocol was provided to each of the moderators, as well as an observational worksheets and post-session interviews.

Data analysis

A transcript of each of the sessions was built using the video recordings and the written notes on the observational worksheets. Transcripts and actions or behaviors, based on the video recordings, were edited to get the participants' technique said, and the participant's technique observed but not said during the dough preparation. Common or similar terms were grouped together into a category. Results include actions that were verbalized, as well as actions that were observed but not said. Observations of the application of the technique, participants and moderators' performance, limitations and advantages were also recorded.

Results and Discussion

Previous studies show that consumers express little awareness towards food texture, taking it for granted. This was shown during the study with expressions done by preparers such as “you just know it,” “it is something you cannot describe,” “there is not a way of saying it,” “you just know from experience,” or “I never stopped to think about it before.” The use of a technique like Think Aloud forced participants to prepare a dough while verbalizing the process, which helped them to be aware and speak out the perceived textures of the doughs and the decision making process while preparing them (Szczeniak, 1971). The techniques used by participants during the dough preparation are shown in Table 3.1.

The verbalization of the process allowed the identification of some techniques that otherwise could not be detected by pure observation. For example, *breaking lumps*, *adding flour when sticky/wet*, or *too dry, it needs more water*. These are techniques performed and mentioned by the participants that are required to obtain a good dough and that are detected through to the perceived texture of the product. While analyzing the results, the researcher cannot feel the product or experience that participants are feeling. The verbalization of these decision-making stages through the Think Aloud technique allowed the identification of more issues compared to what could have been identified by only observing the subjects or in a silent situation (Bruun & Stage, 2015).

Results show that, except for *Pressing/Pushing/squeezing* and *scraping the bowl* during the corn dough preparation, most of the participants verbalized the techniques used and fewer times the techniques were identified as result of observation. Actions or techniques mentioned the most, such as *circular motions/stirring* or *incorporating all together*, were the ones used the most by participants during the dough preparation. Results indicate the Think Aloud technique can be

used by itself to identify descriptions, motivations and actions performed by consumers while performing a task without an additional observational analysis from the researcher. This allows the elimination of some concerns that usually arise with observational studies such as the subjectivity of the method and the difficult and time consuming data analysis (Jervis & Drake, 2014).

During the corn study *Pressing/Pushing/squeezing* and *scraping the bowl* were identified more by observation rather than by what participants said. This can be related to participants' expertise of the task; 84% of corn dough preparers mentioned they prepared corn dough products daily or weekly. Even when participants were not professional cooks, most of the corn dough preparers had a high expertise on dough preparation (based on the frequency of preparation). Research shows that people more knowledgeable of the task usually cannot explain their actions. They perform the exercise faster and as a routine without thinking about it (van Someren et al., 1994).

Table 3.1. Techniques mentioned and observed by participants when preparing a wheat dough (n=43) and a corn dough (n=50).

Technique	Wheat (count)		Corn (count)	
	Said	Observed but not said	Said	Observed but not said
<i>Circular motions/Stirring</i>	27	9	25	6
<i>From the edges to the center</i>	10	3	0	3
<i>Incorporating all together</i>	25	0	25	11
<i>Scraping the bowl</i>	18	9	3	15
<i>Folding the mix or the dough</i>	25	13	12	7
<i>Well in the center</i>	11	2	1	0
<i>Adding water, a little bit at a time</i>	20	11	15	2

Table 3.2. Techniques mentioned and observed by participants when preparing a wheat dough (n=43) and a corn dough (n=50) (continuation).

Technique	Wheat (count)		Corn (count)	
	Said	Observed but not said	Said	Observed but not said
<i>Breaking lumps</i>	7	0	8	0
<i>Adding flour when sticky/wet</i>	30	0	6	0
<i>Pressing/Pushing/Squeezing the dough</i>	28	15	21	29
<i>Quarter turn</i>	7	0	NA	NA
<i>Using the heel/palms of the hand</i>	7	5	NA	NA
<i>Flouring the surface</i>	29	9	NA	NA
<i>Too dry, needs more water</i>	16	0	20	0

Based on the current study, multiple advantages and disadvantages of the Think Aloud technique were identified for the application on the sensory field. All of this, as well as the needs to obtain these advantages, and the remedies to overcome the disadvantages are listed on Table 3.3.

In the current study, the Think Aloud technique showed to be a useful tool for the description of the dough preparation process. Multiple techniques were identified based on what preparers said. However, in order for this technique to be useful, the objectives of the research need to be clearly stated and understood by the leader of the research and all the moderators (Chambers & Smith, 1991; Lawless & Heymann, 2010).

The verbalization process during the dough preparation helped retrieve information regarding the motivations and the actions these inspired. This is one of the main advantages of the Think Aloud procedure, which provides direct information of an ongoing thinking process (Charters, 2003). However, to accomplish this, multiple factors need to be addressed including

clear stated objectives, well trained moderators that understand their role and the objectives of the research, and an environment that allows the subject to feel comfortable and to develop the task.

The use of the Think Aloud technique avoids memory errors, which can produce incomplete or false reports (Ericsson, 1993). The present study allowed participants to describe the dough preparation process while they were doing it, instead of requiring them to remember what they usually do. To achieve this, the environment was setup in the most natural way possible and participants were given the main utensils and/or products needed for the study. Since the technique involved speaking aloud, some researchers also recommend providing participants with water (Charters, 2003; Maughan, 2015; van Someren et al., 1994).

In a cooking study like the present one, is also recommended to give participants a quick overview of what is available in the kitchen. It is also recommended to let participants know that the objective of the study is to understand the process, and that there are no hidden, additional objectives. Telling participants “there is no wrong in what you do”, or “everything you do is fine, we just want to understand your process” proved to help them feel familiarized and comfortable (Maughan, 2015; van Someren et al., 1994).

The use of consumers’ language is another main advantage of this technique; however, the moderator plays a key role on this. In its original form, the Think Aloud technique does not lead to disturbance of the moderator (Ericsson, 1993). During the present study, it was common that some participants forgot to think aloud and it was required to encourage them to think aloud and describe the dough preparation procedure to obtain terms and descriptions of the process. Less terms and descriptions were obtained when participants were not encouraged or reminded by the moderator to think aloud. Evidence suggests that this kind of interference from the moderator does not add an effect to the cognitive process, keeping in mind that the subject is already aware that he

or she is being studied. However, an adequate and exhaustive training of the moderators, including multiple practical exercises, and clear and stated guidelines are required to guarantee his or her interventions are not biasing the participant (Boren & Ramey, 2000; van Someren et al., 1994).

The use of consumers' terms has proved to be useful in sensory science. Consumers' terms derived from the thinking aloud process can be used as an initial phase for a lexicon development, as well as to understand better consumers' perceptions of products and attributes that are important for them (Becue-Bertaut & Le, 2011; Dooley, Adhikari, & Chambers, 2009; L. Lawless & Civille, 2013).

The Think Aloud technique requires the researcher to only analyze what was verbalized by the subject, which makes the analysis of the results easier. Rather than interpret actions and behaviors performed by the subjects, the sensory scientists only need to analyze what the participant said. This also avoids the disadvantages of the observational studies previously mentioned (Jervis & Drake, 2014; van Someren et al., 1994).

Regarding the disadvantages related to the method, one is that the data collected depends on the subjects' ability to communicate and verbalize their motivations. A screening process that looks for participants that are not shy and that express their thoughts easily is recommended. The screening process for the present study required dough preparers to agree to participate in a cooking session where they would explain a researcher what they were doing. All the preparers agreed to participate. However, even when they were asked to think aloud some participants did not do it or did it for a short amount of time and then stopped. For example, every time one of the corn preparers was asked "how did you decide to....?", she said *I do not know*. A second telephone screening after the online screening might be recommended to avoid these situations. Asking

additional questions and talking to the subjects could give the researcher an idea of the subject's ability to communicate (Muñoz, 2005).

The warm up exercises where participants were presented with activities that required them to think aloud represent another technique that can be used to determine participants' ability to communicate and use the method. This requires a detailed observation by the moderator, who at this stage can feel free to interfere as much as needed, as well as to re-explain the technique (Chambers et al., 2001; Ericsson, 1993). Van Someren (1994) recommends giving participants different exercises during 5 to 15 minutes. If after 15 minutes, the subjects still has problems verbalizing his or her actions, it is better to stop the session since it is unlikely they will be able to apply the technique.

Another disadvantage is if participants are asked to verbalized actions that for them cannot be expressed. Verbalizing these non-verbal actions which they are not thinking about might interrupt the cognitive process. This could cause participants to be more concerned about how to explain what they say rather than verbalizing the process (van Someren et al., 1994). For example, during the wheat dough preparation, one of the participants was preparing the product and thinking aloud, but she was interrupted by the moderator who asked her to spell a word she just said. This action interrupted the cognitive process of the participant and changed it to one where she had to think about the spelling of the word. This issue can be addressed by adequate training of the moderators, so that the questions asked are in a natural way, not pushing the respondents to develop an extra cognitive process and letting the process flow. Moderators should only interfere when subjects are not talking, without helping the subjects when they are stuck, or giving them words that can describe the process (Axelrod, 1975; Chambers & Smith, 1991).

There are different studies that compare the time that it takes for subjects to perform a task using the Think Aloud technique and not using it. Results vary; some researchers mention that the use of the technique increased the time up to 50%, while others mention it did not have a significant effect (Bruun & Stage, 2015; Ericsson, 1993). From the dough preparation sessions, it was clear those participants that talked more usually took more time for the preparation. However, this is a characteristic intrinsic to the method that cannot be avoided.

Another disadvantage that comes with the method and that is unavoidable is the time-consuming data analysis. It is recommended to record the interviews, this way moderators do not need to be concerned on taking notes during the session. Moderators should be able to focus on making the subject talk. The data analysis will require a video analysis and transcripts of each video to later obtain terms and descriptions that summarize what was mentioned by participants (Chambers & Smith, 1991). Some authors also recommend collecting other factors such as tone of voice; however, the data retrieved from the sessions is highly dependent on the objective of the research (Charters, 2003).

Table 3.3. Advantages, disadvantages, needs and remedies of the application of the Think Aloud technique in a sensory research.

Advantages	Needs
Useful tool for a process description	Objectives clearly stated
	Objectives clearly stated
Results include actions and motivations of subjects	Moderators should encourage/remind participants to keep thinking aloud
	Practical exercise in the most natural environment possible with the materials needed on hand.
Information retrieved does not depend on memory	Practical exercise in the most natural environment possible with the materials needed on hand.

Table 3.4. Advantages, disadvantages, needs and remedies of the application of the Think Aloud technique in a sensory research (continuation).

Advantages	Needs
Allows consumers use their own language	Moderators should encourage/remind participants to keep thinking aloud
Avoids interpretation of the subjects' behavior	Moderators should encourage/remind participants to keep thinking aloud.
Disadvantages	Remedies
Data collected depends on the subjects' verbal ability	Adequate screening process Warm up exercises
Asking participants to verbalized non – verbal information can disrupt the cognitive process	Adequate training of moderators
Verbalization process makes the task last longer	None
Time consuming data analysis	None

The use of a final, post - Think Aloud session interview helped expand the results as participants retrieved the experience they just had. In this study, participants were asked to explain the dough preparation process, only using words. Answers from these interviews helped complete and prove terms, techniques, and descriptions related to the data collected during the dough preparation. During these interviews, participants were less concerned of performing the task. They did not depend any more on their working memory, but still had fresh information of the task they just performed. The use of a short interview after the performance of the task can give a better understanding of participants' motivations (Chambers & Smith, 1991; Charters, 2003).

A final recommendation for the application of the Think Aloud technique, is to write down a clear and detailed outline of the protocol which includes how the moderators introduce themselves to the subjects, how moderators explain the task to the participant, what to say in

specific circumstances (like if subjects stop talking), and how to record the results. This protocol should be handed and clearly explained to all moderators. It is recommended to test it to make sure it is working the way it is supposed to and that the moderators are able to follow it (Chambers & Smith, 1991; Ericsson, 1993; van Someren et al., 1994).

Practical Applications

Based on this research, there are multiple applications of the Think Aloud technique in sensory research. The technique has been used before to understand the cognitive process as described by Chambers et al. (2001). As shown in this study, the technique helps understanding the preparation process of a food product, including the motivations that encourage preparers to make a decision, and the actions they perform based on these decisions. With this, the method represents a good tool for collecting data about people's behavior at the kitchen. However, other applications include the study of shopping behaviors (for example, how do people decide what to buy at the grocery store), or how people use products at home (like cosmetics and lotions). It is as well, a useful tool for retrieving consumers' terms and experiences of a product in different stages of its use; and to understand the challenges people deal with when using a product.

Limitations

One of the limitations of this study was that all the data analysis was done by one person. Previous studies who applied focus groups or other qualitative research used more than one person evaluating the results in order to avoid any bias or subjectivity (Jervis & Drake, 2014; Jervis, Lopetcharat, & Drake, 2012).

On the other hand, data collected in Costa Rica was in Spanish. This data was later translated by a native Spanish speaker who was also Costa Rican. However, even when some terms were given the closest translation, as stated by Zannoni (1997), some concepts come from a

specific view of reality that is typical of the culture, and some specific words might not have a translation to another language.

Conclusions

The Think Aloud technique is a useful tool that can provide valuable data about consumers' actions and motivations using their own language. The technique can be applied to the sensory science field, allowing consumers to communicate their experience as they are participating in an ongoing process. This allows them to communicate their immediate experience rather than retrieving from their memory. However, the application of the technique involves some requirements, including objectives clearly stated and appropriate training of moderators.

However, some disadvantages are intrinsic to the technique. For example, the time-consuming data analysis. The Think Aloud technique represents a good technique to get data that later can be transformed into quantitative data to be analyzed in hedonic tests or descriptive panels.

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Appendix A - **Basic, not detailed recipes given during observational studies**

Wheat dough recipe

Recommended bread dough recipe

Ingredients

- 2.5 cups of flour (312 g)
- 2 teaspoons of instant yeast (6.2 g)
- 1 teaspoons of salt (5.7 g)
- 1 cup of water (240 mL or 240 g)
- Oil as needed

Procedure

1. Mix the dry ingredients: yeast, salt and 2/3 of the flour in a bowl.
2. Then, add the oil (if required, as needed), and half of the water.
3. Use a wooden spoon to stir the mix, then add the other half of water.
4. Continue stirring with the wooden spoon. When it is ready, turn the dough onto a floured board to knead.
5. Add the rest of the flour as you need.

Corn dough recipe

Receta recomendada para la preparación de tortilla

Ingredientes

- 1 taza de harina de maíz (125 g)
- 3/4 taza de agua (177 mL o 177 g)
- 1/4 cucharadita de sal (1.4 g)

Procedure

1. Mezcle la harina y la sal
2. Añada el agua hasta tener la masa.
3. Moldee las tortillas con la mano.

Appendix B - Materials for data collection during dough preparation sessions.

Wheat dough study

Observation worksheet

Participant ID: _____ Interviewer: _____ Date: _____

<i>Question/observation</i>	<i>Response</i>	<i>Comments</i>
<i>Read the recipe? (Y/N)</i>		
<i>Measured ingredients? (Y/N)</i>		
<i>If yes, what they used? (Household/scale)</i>		
<i>What amount of ingredients they mentioned they used?</i>	<i>Flour:</i> <i>Salt:</i> <i>Yeast:</i> <i>Water:</i> <i>Oil:</i>	
<i>Temperature of water they mentioned they used.</i>		
<i>Temperature of water used (°F)</i>		
<i>How they mixed the water and the flour (rotation, hand, spoon?).</i>		
<i>Time for mixing? (min)</i>	<i>Start:</i> <i>End:</i>	
Take pictures of the mix		
<i>Time for kneading? (min)</i>	<i>Start:</i> <i>End:</i>	
<i>How they determined the readiness of the dough after kneading?</i>		
<i>Handfeel (Y/N), how?</i>		
<i>Trying the sample (Y/N), how?</i>		
<i>Other? (Y/N)</i>		
<i>What attributes/words they used to describe the readiness while preparing it?</i>		
Take pictures of the dough		

Post session interview

Participant ID: _____ Interviewer: _____ Date: _____

1. How similar was the preparation of the dough you did today to the way you would prepare it in your own kitchen?
2. How did you decided that the mixing and kneading stages were ready or done? For example, if you need to explain or teach this to someone else, just using words, how would you do it, what words would you use to explain it?

Mixing:

Kneading:

Corn dough study

Observation worksheet

Participante: _____ Entrevistador: _____

Fecha: _____

<i>Observation/ Pregunta</i>	<i>Respuesta</i>	<i>Comentarios</i>
<i>Lee la receta (S/N)</i>		
<i>Pesa los ingredientes (S/N)</i>		
<i>¿Si los pesa, cómo los pesa? (tazas medidoras o balanza)</i>		
<i>¿Qué cantidad de ingredientes dice el participante usar?</i>	<i>Harina:</i> <i>Sal:</i> <i>Agua:</i>	
<i>Temperatura del agua que dice el participante usar</i> <i>Temperatura</i>	 ____F	
<i>Tiempo de mezclado</i>	<i>Inicio:</i>	
<i>¿Cómo mezcla los ingredientes? (¿con la mano o con utensilios? ¿Qué clase de movimiento realiza?</i>		
<i>Atributos o características utilizadas para describir la masa en el proceso</i>		
<i>Tiempo de mezclado</i>	<i>Final:</i>	
<i>¿Cómo determinó que la masa estaba lista? Listar los atributos, descriptores o características usados por la consumidora.</i>		
<i>¿Con la mano? (S/N, ¿Cómo lo describe?</i>		
<i>¿Prueba el sabor de la masa? (S/N, ¿Cómo lo describe?</i>		
<i>¿Otro? (S/N, ¿Cómo lo describe?</i>		
<i>Tomar fotografía de la masa</i>		

Post session interview

Participante: _____

Entrevistador: _____

Fecha:_____

1. ¿Qué tan similar es la preparación de la masa que preparó el día de hoy a la que usualmente prepara en su casa?
2. ¿Cómo decidió usted que la masa estaba lista? Si tuviera que explicarlo usando únicamente palabras, a alguien que nunca lo ha hecho antes, ¿cómo lo explicaría?

Appendix C - Cooking habits of participants

Dough preparation studies

Table C.1. Frequency of preparation of similar doughs by preparers who participated in the studies (43 wheat dough preparers and 50 corn dough preparers).

Frequency	Wheat (%)	Corn (%)
Daily	0	14
Weekly	19	72
Monthly	30	12
Once every few months	33	2
Once a year	12	0
Less often than a year	7	0

Table C.2. Products prepared in the last 3 months prior the study by dough preparers (43 wheat dough preparers and 50 corn dough preparers).

Wheat		Corn	
Product	%	Product	%
Yeast breads	74	Empanadas	96
Pizza dough	60	Tortillas	96
Biscuits	60	Bizcochos	34
Cookies	77	Others (not doughs)	60
Other batters (not doughs)	98	-	-

Online surveys

Table C.3. Respondents habits (per study, n=300)

Habit	Wheat (%)	Corn (%)
Reasons respondents gave for not cooking/baking more often yeast breads or corn tortillas		
I do not know how	27	32
I do not have time	30	25
I do not like baking/cooking	10	8
I am not a good baker/cook	14	11
I prefer cooking products other than yeast bread	19	23
Sources of information to learn how to bake/cook yeast breads or corn tortillas		
Baking classes or workshops	4	3
Magazines	4	4
TV shows	5	7
Written recipes on the Internet	25	30
A friend or family member	15	15
Cooking books	22	15
Videos on the Internet	23	23
Other (please specify)	1	1

Table C.4. Frequency of food habits of respondents (per study, n=300).

Habit	Never (%)		Rarely (%)		Occasionally (%)		Often (%)		Always (%)	
	Wheat	Corn	Wheat	Corn	Wheat	Corn	Wheat	Corn	Wheat	Corn
Specifically, for yeast bread or corn tortillas recipes										
Read instructions	5	10	4	5	10	12	17	27	64	45
Follow instructions	6	10	3	5	8	8	17	23	67	54
Overall, for all recipes										
Habit	Follow usually (%)		Follow sometimes (%)		Follow seldom (%)					
	Wheat	Corn	Wheat	Corn	Wheat	Corn				
Ingredients (types and amounts)	86	82	9	10	4	8				
Cooking temperatures	85	78	10	13	5	9				
Cooking/Preparation time	78	75	16	15	7	10				
Assembly directions	78	72	17	20	6	8				
Mixing directions	81	75	15	16	4	8				
Kneading directions	79	NA	16	NA	5	NA				

Appendix D - Qualtrics survey

Start of Block: Screener

C1.1 Which of the following categories best describes your age?

- ☐ 17 or less (1)
- ☐ 18-34 (2)
- ☐ 35-44 (3)
- ☐ 45-54 (4)
- ☐ 55-64 (5)
- ☐ 65 or older (6)

Skip To: End of Block If Which of the following categories best describes your age? = 17 or less

C1.2 Are you a professional baker or cook?

- ☐ Yes (1)
- ☐ No (2)

Skip To: End of Block If Are you a professional baker or cook? = Yes

C1.3 How would you rate your cooking abilities?

- ☐ Novice (1)
- ☐ Basic skills (2)
- ☐ Average (3)
- ☐ Better than average (4)
- ☐ Expert (5)

Skip To: End of Block If How would you rate your cooking abilities? = Better than average

Skip To: End of Block If How would you rate your cooking abilities? = Expert

C1.4 Which of the following foods have you consumed in the past month? (check all that apply)

- ☐ Apples (1)
- ☐ Bread (2)
- ☐ Live worms (3)
- ☐ Beef (4)

- Cheese (5)
- Chocolate (6)
- Pickled chicken (7)
- Eggs (8)
- Vegetable stew (9)
- Hot dogs/Frankfurters (10)
- Potato chips/crisps (11)
- Tortillas (12)

C1.5 How often have you made yeast bread from scratch in the past 5 years (do not count using a bread machine)?

- Never (1)
- Once or twice (2)
- Sometimes (3)
- Often (4)

Skip To: End of Block If How often have you made yeast bread from scratch in the past 5 years (do not count using a bread... = Sometimes

Skip To: End of Block If How often have you made yeast bread from scratch in the past 5 years (do not count using a bread... = Often

C1.6 This survey is focused on recipes for making yeast bread. If you are interested in learning more about making yeast bread click continue, otherwise click exit.

- Continue (1)
- Exit (2)

Skip To: End of Block If This survey is focused on recipes for making yeast bread. If you are interested in learning more... = Exit

End of Block: screener

Start of Block: Recipe validation

C2.1 Please read the yeast bread recipe below and answer the questions below.

C2.2 How would you rate the ease of use of this recipe?

- ☐ Very easy (1)
- ☐ Easy (2)
- ☐ Somewhat easy (3)
- ☐ Neither difficult nor easy (4)
- ☐ Somewhat difficult (5)
- ☐ Difficult (6)
- ☐ Very difficult (7)

C2.3 How likely would you be to use this recipe at home if you had it available?

- ☐ Extremely unlikely (1)
- ☐ Very unlikely (2)
- ☐ Unlikely (3)
- ☐ Neutral/not sure (4)
- ☐ Likely (5)
- ☐ Very likely (6)
- ☐ Extremely likely (7)

C2.4 How would you rate the amount of information given in this recipe?

- ☐ Far too little (1)
- ☐ Too little (2)
- ☐ Neither too much nor too little (3)
- ☐ Too much (4)
- ☐ Far too much (5)

C2.5 How much do you like the instructions given in this recipe?

- ☐ Dislike extremely (1)
- ☐ Dislike very much (2)

- Dislike moderately (3)
- Dislike slightly (4)
- Neither like nor dislike (5)
- Like slightly (6)
- Like moderately (7)
- Like very much (8)
- Like extremely (9)

C2.6 Please answer the next question about the format of the recipe.

I think the format of this recipe is:

- Not at all helpful/1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)
- 8 (8)
- Extremely helpful/9 (9)

C2.7 What did you like about this recipe? (check all that apply)

- That it uses household measurements (that is, cups, tablespoons, teaspoons) (1)
- Utensils list (2)
- Ingredients list (3)
- The initial setup is described (4)
- The dough making procedure (5)
- The forming and baking procedure (6)
- Times in the initial setup (7)
- Times in the forming and baking procedure (8)
- The process of mixing the dry ingredients (9)
- The process of mixing wet and dry ingredients (10)
- Times in the dough making procedure (11)

- The length of the recipe (12)
- That it has images (13)
- That it does not have images (14)
- Temperatures in the initial setup (15)
- Temperatures in the dough making procedure (16)
- Temperatures in the forming and baking procedure (17)
- That the recipe is not very detailed (18)
- That the recipe is very detailed (19)
- The kneading process (20)
- The description of the ready dough (21)

Skip To: End of Block If What did you like about this recipe? (check all that apply) = That it has images

C2.8 What did you not like about this recipe? (check all that apply)

- That it uses household measurements (that is, cups, tablespoons, teaspoons) (1)
- Utensils list (2)
- Ingredients list (3)
- The initial setup is described (4)
- The dough making procedure (5)
- The forming and baking procedure (6)
- Times in the initial setup (7)
- Times in the forming and baking procedure (8)
- The process of mixing the dry ingredients (9)
- The process of mixing wet and dry ingredients (10)
- Times in the dough making procedure (11)
- The length of the recipe (12)
- That it has images (13)
- That it does not have images (14)
- Temperatures in the initial setup (15)
- Temperatures in the dough making procedure (16)
- Temperatures in the forming and baking procedure (17)
- That the recipe is not very detailed (18)

- That the recipe is very detailed (19)
- The kneading process (20)
- The description of the ready dough (21)

End of Block: Recipe validation

Start of Block: Demographics

C7.1 Thank you very much for your answers, please answer some final demographic questions

C7.2 Which if the following best describes your gender?

- Male (1)
- Female (2)
- Prefer not to answer (3)

C7.3 Which of the following categories best describes your age?

- 18-24 (1)
- 25-34 (2)
- 35-44 (3)
- 45-54 (4)
- 55-64 (5)
- 65 or older (6)

C7.4 Which of the following best describes your ethnicity?

- White, not of Hispanic origin (1)
- Black, not of Hispanic origin (2)
- Asian or Pacific Islander (3)
- American Indian or Alaskan (4)
- Native Hispanic (5)
- Prefer not to answer (7)

C7.5 Why do you think you do not bake yeast bread more often? (check all that apply)

- ☐ I do not know how (1)
- ☐ I do not have time (2)
- ☐ I do not like baking/cooking (3)
- ☐ I am not a good baker/cook (4)
- ☐ I prefer cooking products other than yeast bread (5)

C7.6 If you were going to learn how to bake yeast bread, where would you go for information or instructions? (check all that apply)

- ☐ Baking classes or workshops (1)
- ☐ Magazines (2)
- ☐ TV shows (3)
- ☐ Written recipes on the Internet (4)
- ☐ A friend or family member (5)
- ☐ Cooking books (6)
- ☐ Videos on the Internet (7)
- ☐ Other (please specify) (8) _____

C7.7 If you use a recipe to bake a yeast bread, how often do you **read** the directions?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Occasionally (3)
- ☐ Often (4)
- ☐ Always (5)

C7.8 If you use a recipe to bake a yeast bread, how often do you **follow** the directions?

- ☐ Never (1)
- ☐ Rarely (2)
- ☐ Occasionally (3)
- ☐ Often (4)
- ☐ Always (5)

C7.9 Can you please indicate how often you check the following items in a yeast bread recipe.

	How often do you check the following items in a yeast bread recipe?		
	Follow usually (1)	Follow sometimes (2)	Follow seldom (3)
Ingredients (types and amounts) (1)			
Cooking temperatures (2)			
Cooking/Preparation time (3)			
Assembly directions (4)			
Mixing directions (5)			
Kneading directions (6)			

End of Block: Demographics

Appendix E - Contingency tables built from CATA data

Table E.1. Factors respondents mentioned they liked in each recipe.

Products\Dimensions		Wheat (count)					Corn (count)				
		Detailed	Images	Not detailed	Paragraph	Very detailed	Detailed	Images	Not detailed	Paragraph	Very detailed
<i>That it uses household measurements</i>	A	78	77	90	72	75	83	71	61	60	81
<i>Utensils list</i>	B	78	74	36	19	63	70	76	20	11	65
<i>Ingredients list</i>	C	118	109	135	67	115	112	130	114	67	113
<i>The initial setup is described</i>	D	46	47	42	55	51	49	50	50	41	45
<i>The dough making procedure</i>	E	75	79	60	73	66	75	73	58	72	73
<i>Times in the initial setup</i>	F	25	31	30	20	35	21	31	21	19	25
<i>The process of mixing the dry ingredients</i>	G	67	57	59	55	72	NA	NA	NA	NA	NA
<i>The process of mixing wet and dry ingredients</i>	H	84	69	54	63	68	NA	NA	NA	NA	NA
<i>Times in the dough making procedure</i>	I	46	52	34	35	42	27	28	18	18	31
<i>The length of the recipe</i>	J	64	78	93	66	30	69	77	118	69	43
<i>That it has images</i>	K	0	221	0	0	0	0	211	0	0	0
<i>That it does not have images</i>	L	15	0	18	27	25	12	0	27	17	21
<i>Temperatures in the initial setup</i>	M	24	26	22	23	31	19	12	14	14	14
<i>Temperatures in the dough making procedure</i>	N	27	30	20	25	31	20	19	16	21	19
<i>That the recipe is not very detailed</i>	O	10	13	23	15	4	5	13	23	22	6
<i>That the recipe is very detailed</i>	P	107	111	79	102	120	125	104	57	84	131
<i>The kneading process</i>	Q	78	76	37	63	59	NA	NA	NA	NA	NA
<i>The description of the ready dough</i>	R	57	74	34	55	57	71	60	28	61	67

Table E.2. Factors respondents mentioned they did not like in each recipe.

Products\Dimensions		Wheat (count)					Corn (count)				
		Detailed	Images	Not detailed	Paragraph	Very detailed	Detailed	Images	Not detailed	Paragraph h	Very detailed
<i>That it uses household measurements</i>	A	5	5	2	6	6	6	7	7	3	8
<i>Utensils list</i>	B	23	34	13	31	11	23	35	27	27	21
<i>Ingredients list</i>	C	14	14	11	45	19	17	11	15	42	16
<i>The initial setup is described</i>	D	15	23	16	19	16	26	27	21	18	18
<i>The dough making procedure</i>	E	8	17	21	10	12	23	23	34	29	20
<i>Times in the initial setup</i>	F	8	34	8	17	23	17	30	18	12	13
<i>The process of mixing the dry ingredients</i>	G	10	13	14	8	12	NA	NA	NA	NA	NA
<i>The process of mixing wet and dry ingredients</i>	H	5	11	21	15	16	NA	NA	NA	NA	NA
<i>Times in the dough making procedure</i>	I	7	15	9	11	14	12	19	11	18	14
<i>The length of the recipe</i>	J	46	57	28	50	110	70	58	24	59	94
<i>That it has images</i>	K	0	13	0	0	0	0	15	0	0	0
<i>That it does not have images</i>	L	161	0	161	148	144	149	0	159	155	145
<i>Temperatures in the initial setup</i>	M	11	19	3	8	6	7	15	7	7	3
<i>Temperatures in the dough making procedure</i>	N	4	20	4	5	2	7	20	5	2	8
<i>That the recipe is not very detailed</i>	O	11	12	57	18	8	11	22	60	34	7
<i>That the recipe is very detailed</i>	P	17	21	8	16	52	31	18	3	22	49
<i>The kneading process</i>	Q	12	23	34	23	19	NA	NA	NA	NA	NA
<i>The description of the ready dough</i>	R	6	7	16	5	10	5	13	27	12	7

Appendix F - Correlations and cluster analysis of recipes validation

Pearson's correlations

Table F.1. Pearson's correlation matrix for wheat recipes validation (n=300).

Variables	Likeability of instructions	Format helpfulness	Ease	Amount of information	Likelihood to use it
<i>Likeability of instructions</i>	1	0.805	0.632	-0.228	0.688
<i>Format helpfulness</i>	0.805	1	0.578	-0.132	0.607
<i>Ease</i>	0.632	0.578	1	-0.269	0.644
<i>Amount of information</i>	-0.228	-0.132	-0.269	1	-0.214
<i>Likelihood to use it</i>	0.688	0.607	0.644	-0.214	1
<i>Values in bold are different from 0 with a significance level $\alpha=0.05$</i>					

Table F.2. Pearson's correlation matrix for corn recipes validation (n=300).

Variables	Likeability of instructions	Format helpfulness	Ease	Amount of information	Likelihood to use it
<i>Likeability of instructions</i>	1	0.768	0.656	-0.100	0.728
<i>Format helpfulness</i>	0.768	1	0.539	-0.040	0.595
<i>Ease</i>	0.656	0.539	1	-0.211	0.664
<i>Amount of information</i>	-0.100	-0.040	-0.211	1	-0.093
<i>Likelihood to use it</i>	0.728	0.595	0.664	-0.093	1
<i>Values in bold are different from 0 with a significance level $\alpha=0.05$</i>					

Appendix G - Recipes validates

Wheat recipes

Not detailed, step by step format, wheat recipe

Makes 2 loaves of bread

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Ingredients

- 3 cups of all purpose wheat flour
- 2 cups of warm water
- 1.5 teaspoon of salt
- 1 packet of instant dry yeast
- 2 tablespoons of vegetable oil

Dough making procedure

1. Mix the dry ingredients: yeast, salt and 2/3 of the flour in a bowl.
2. Then, add the oil (if required, as needed), and half of the water.
3. Use a wooden spoon to stir the mix, add the other half of water as needed.
4. Continue stirring with the wooden spoon. When it is ready, turn the dough onto a floured board to knead.
5. Add the rest of the flour as needed.

Forming and baking procedure

1. Put the ball of dough in a clean bowl and cover it with plastic wrap
2. Let the dough rise for 30 minutes to an hour, until it doubles in size.
3. Grease a loaf pan.
4. Shape the dough into a rectangle about the size of the loaf pan.
5. Put the dough in the pan.
6. Preheat the oven to 425 °F (or 215 °C)
7. Let the dough rest another 30 minutes to an hour, before baking it.
8. Bake the dough 25-30 minutes until it is golden brown.
9. Let it cool down for at least 30 minutes
10. Remove from the pan

Very detailed, step by step format, wheat recipe

Makes 2 loaves of bread

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Utensils

- 1 big bowl
- 1 wooden spoon
- Dry ingredients measuring cups
- Wet ingredients measuring cups
- Thermometer
- Loaf pan

Ingredients

Measure the following ingredients one by one.

- 3 cups of all purpose wheat flour split into two
 - a. 1.5 cups of flour for the initial mixing.
 - b. 1.5 cups of flour to add as needed during mixing and kneading.
- 2 cups of warm water (110 °F/43°C)
- 1.5 teaspoon of salt
- 1 packet of instant dry yeast (7 g)
- 2 tablespoons of vegetable oil

Dough making procedure (~30 seconds)

Mixing dry ingredients

1. In a large bowl add the following ingredients:
 - a. 1.5 cups of flour
 - b. 1.5 tsp of salt
 - c. 1 packet of instant dry yeast
2. Use a wooden spoon:
 - d. Mix using circular motions, scraping the mix from the sides towards the center.
 - e. Mix until all the dry ingredients are evenly distributed, use the yeast as a guide since it is a different color.

Mixing of wet and dry ingredients (~4 minutes)

1. Make a well in the center of the dry ingredients.
2. Add 3/4 cup of the water into the well.
3. Add the oil into the well.
 - a. Stir the wet and dry ingredients together using the wooden spoon
 - b. As the dough begins to form, fold the dough into itself as you scrape the mix from the sides to the center incorporating all the ingredients together.
 - c. Press the dough down to break any lumps.
4. Look at your dough after mixing it:
 - a. If it looks dry and there is loose flour, add water, 1 tablespoon at a time and continue mixing.

- b. If it looks too sticky and there is too much water that is not being incorporated, add $\frac{1}{4}$ of a cup of flour and continue mixing.
5. Your dough will be ready when the mixing gets harder and you have one lump-free ball that is sticky, but you can still handle with your hands. The dough should pull away from the sides of the bowl with no liquid left in the bowl and no loose flour.

Kneading (~5-10 minutes)

1. On your kneading surface (either a cutting board or a counter top), spread $\frac{1}{4}$ cup of flour, creating a thin layer. Use this flour to cover your hands as well.
2. Scrape the dough out of the bowl onto the floured surface.
3. Start kneading it:
 - a. Using your hands, roll the dough back and forth over the floured surface, covering it all with flour.
 - b. With the heels of your hands, push the dough down spreading it away from you, then fold the dough in half and turn it in a quarter turn.
 - c. Repeat **step b** 3 times.
 - d. If the dough is still sticky, roll it again on the flour that is left on your kneading surface; if you already used all the flour, add another tablespoon of it on the surface, repeat **steps a and c**.
 - e. Continue **steps a to d** until the dough is no longer sticky.
 - f. Once the dough is not sticky, repeat **step b** until you get a smooth and elastic ball of dough so that when you touch it with one of your fingers, it springs back.
4. Form the dough into a ball.

Forming and baking procedure

1. Put the ball of dough in a clean bowl and cover it with plastic wrap
2. Let the dough rise for 30 minutes to an hour, until it doubles in size.
3. Grease a loaf pan.
4. Shape the dough into a rectangle about the size of the loaf pan.
5. Put the dough in the pan.
6. Preheat the oven to 425°F (or 215 °C)
7. Let the dough rest another 30 minutes to an hour, before baking it.
8. Bake the dough 25-30 minutes until it is golden brown.
9. Let it cool down for at least 30 minutes
10. Remove from the pan

Detailed, step by step, wheat recipe

Makes 2 loaves of bread

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Utensils

- 1 big bowl
- 1 wooden spoon
- Dry ingredients measuring cups
- Wet ingredients measuring cups
- Thermometer
- Loaf pan

Ingredients

Measure the following ingredients one by one.

- 3 cups of all purpose wheat flour
- 2 cups of warm water (110°F/43°C)
- 1.5 teaspoon of salt
- 1 packet of instant dry yeast (7 g)
- 2 tablespoons of vegetable oil

Dough making procedure

Mixing dry ingredients

1. In a large bowl add 1.5 cups of flour, 1.5 tsp of salt and 1 packet of instant dry yeast
2. Use a wooden spoon to mix the ingredients, until all they are evenly distributed.

Mixing of wet and dry the ingredients

1. Add 3/4 cup of the water and the oil, stir using the wooden spoon.
 - a. If the dough looks dry and there is loose flour, mix in 1 tablespoon of water
 - b. If there is water not incorporated, mix in 1/4 cup of flour
2. Your dough will be ready when you have one lump-free ball that is sticky, but you can still handle with your hands.

Kneading

1. Spread flour on your kneading surface, apply it on your hands and on the surface of the dough.
2. Scrape the dough out of the bowl onto the floured surface.
3. With the heels of your hands, push the dough down, then fold it in half and turn it in a quarter turn; repeat 3 times.
4. If the dough is still sticky, add another tablespoon and continue kneading until it is not sticky.
5. Once the dough is not sticky, continue kneading until you get a smooth and elastic ball of dough.

Forming and baking procedure

1. Put the ball of dough in a clean bowl and cover it with plastic wrap
2. Let the dough rise for 30 minutes to an hour, until it doubles in size.
3. Grease a loaf pan.
4. Shape the dough into a rectangle about the size of the loaf pan.
5. Put the dough in the pan.
6. Preheat the oven to 425°F (or 215 °C)
7. Let the dough rest another 30 minutes to an hour, before baking it.
8. Bake the dough 25-30 minutes until it is golden brown.
9. Let it cool down for at least 30 minutes
10. Remove from the pan

Detailed, paragraph format wheat recipe

Makes 2 loaves of bread

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Dough making procedure

Mixing dry ingredients: In a large bowl add 1.5 cups of flour, 1.5 tsp of salt and 1 packet of instant dry yeast. Mix them with a wooden spoon, scraping the mix from the sides of the bowl. Mix until all the dry ingredients are evenly distributed.

Mixing of wet and dry the ingredients: Add 3/4 cup of warm water (110 °F/43°C) and 2 tablespoons of oil, stir using the wooden spoon. If the dough looks dry and there is loose flour, add 1 tablespoon of water; but, if there is water not incorporated, add 1/4 of a cup of flour and continue mixing. Your dough will be ready when you have one lump-free ball that is sticky, but you can still handle with your hands.

Kneading: Use 1/4 cup of flour to spread on your kneading surface, apply on your hands and on the outside of the dough. Scrape the dough out of the bowl onto the floured surface. Using the heels of your hands, push the dough down, then fold the dough in half and turn it in a quarter turn; repeat 3 times. If after this, the dough is still sticky, add another tablespoon of flour on the surface, and continue kneading until it is not sticky. Once the dough is not sticky, continue kneading until you get a smooth and elastic ball of dough.

Forming and baking procedure

1. Put the ball of dough in a clean bowl and cover it with plastic wrap
2. Let the dough rise for 30 minutes to an hour, until it doubles in size.
3. Grease a loaf pan.
4. Shape the dough into a rectangle about the size of the loaf pan.
5. Put the dough in the pan.
6. Preheat the oven to 425 °F (or 215 °C)
7. Let the dough rest another 30 minutes to an hour, before baking it.
8. Bake the dough 25-30 minutes until it is golden brown.
9. Let it cool down for at least 30 minutes
10. Remove from the pan

Detailed, image format, wheat recipe

Makes 2 loaves of bread

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Utensils

- 1 big bowl
- 1 wooden spoon
- Dry ingredients measuring cups
- Wet ingredients measuring cups
- Thermometer
- Loaf pan

Ingredients

- 3 cups of all purpose wheat flour
- 2 cups of warm water (110 °F/43°C)
- 1.5 teaspoon of salt
- 1 packet of instant dry yeast (7 g)
- 2 tablespoons of vegetable oil

Dough making procedure:

Mixing



4-5 minutes



Add 1.5 cups of flour, 1.5 tsp of salt and 1 packet of instant dry yeast. Mix them until all the ingredients are evenly distributed.



Add $\frac{3}{4}$ cup of water and the oil; stir the together. If the dough looks dry and there is loose flour, add 1 tablespoon of water; but, if there is water not incorporated, add $\frac{1}{4}$ of a cup of flour and continue mixing



Your dough will be ready when you have one lump-free ball that is sticky, but you can still handle with your hands.

Kneading

🕒 5-10 minutes



Spread flour on your kneading surface, apply it on your hands and on the surface of the dough. Scrape the dough out of the bowl onto the floured surface.



Push the dough down, then fold the dough in half and turn it in a quarter turn; repeat 3 times. If after this, the dough is still sticky, add another tablespoon of flour on the surface, and continue kneading until it is not sticky.



Once the dough is not sticky, continue kneading until you get a smooth and elastic ball of dough.

Forming and baking procedure

1. Put the ball of dough in a clean bowl and cover it with plastic wrap
2. Let the dough rise for 30 minutes to an hour, until it doubles in size.
3. Grease a loaf pan.
4. Shape the dough into a rectangle about the size of the loaf pan.
5. Put the dough in the pan.
6. Preheat the oven to 425 °F (or 215 °C)
7. Let the dough rest another 30 minutes to an hour, before baking it.
8. Bake the dough 25-30 minutes until it is golden brown.
9. Let it cool down for at least 30 minutes
10. Remove from the pan

Corn recipes

Not detailed, step by step format, corn recipe

Makes 3 tortillas

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Ingredients

- 1.5 cups of corn flour
- 1 cup of warm water (110°F/43°C)
- 1 teaspoon of salt

Dough making procedure

6. Mix the 1 cup of flour and 0.5 teaspoons of salt.
7. Add water a little bit at a time until your dough ready.
8. Add the rest of the flour, salt and water as needed.

Shaping and cooking procedure

1. Preheat the skillet (medium heat)
2. Divide the dough into 3 equal-size balls.
3. Cut a plastic bag along the sides and put it in the tortilla press.
4. Put a ball of dough in the middle of the plastic bag in the press.
5. Flattened the tortilla using the tortilla press.
6. Peel the tortilla away from the plastic.
7. Place the tortilla in the skillet and let it cook for 1 minute.
8. Turn the tortilla over and let it cook on the other side for another minute.
9. Wrap the tortilla in a warm towel to keep it warm.

Very detailed, step by step format, corn recipe

Makes 3 tortillas

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Utensils

- 1 big bowl
- Dry ingredients measuring cups
- Wet ingredients measuring cups
- Measuring spoons
- Thermometer
- A skillet
- A tortilla press
- A zip plastic bag

Ingredients

Measure the following ingredients one by one.

- 1.5 cups of corn flour split into two
 - a. 1 cup of flour for the initial mixing.
 - b. ½ cups of flour to add if needed.
- 1 cup of warm water (110°F/43°C)
- 1 teaspoon of salt (you will add ½ tsp at a time)

Dough making procedure (~3-5 minutes)

1. In a large bowl add the following ingredients:
 - f. 1 cup of flour
 - g. ½ tsp of salt
 - h. ½ cups of water
2. Use your hands to mix all the ingredients together:
 - a. Start with a circular movement as you dissolve the flour in the water
 - i. If the dough is not forming into a ball and it looks lumpy, dry, and there is loose flour, add a tablespoon of water and continue with **step 2**.
3. Once everything is coming together into one ball, do one circular motion around the bowl picking up all the flour or dough stuck to the sides of the bowl, then mash the dough against the bowl using your hand.
4. Repeat **step 3** until the dough forms one ball that does not stick to the bowl.
5. Take a piece of the dough and make one small ball about the size of an egg;
 - a. Flatten the ball between your hands, if:
 - i. The dough sticks to your hands, add another teaspoon of flour and repeat **steps 2 to 4**
 - ii. The dough breaks down into pieces or cracks in the middle, add another teaspoon of water and repeat **steps 2 to 4** (it is ok if there are small cracks on the edges)
6. Try the taste of the dough, is this the amount of salt you like in your tortillas? If not, add another ½ teaspoon of salt and mix it again as in steps **2 and 3**.

7. Your dough is ready when it does not stick to the bowl or your hands and is soft, lump-free, and workable.

Forming and cooking procedure

1. Preheat the skillet (medium heat)
2. Divide the dough into 3 equal-size balls.
3. Cut a plastic bag along the sides and put it in the tortilla press.
4. Put a ball of dough in the middle of the plastic bag in the press
5. Flatten the tortilla using the tortilla press
6. Peel the tortilla away from the plastic
7. Place the tortilla in the skillet and let it cook for 1 minute
8. Turn the tortilla over and let it cook on the other side for another minute
9. Wrap the tortilla in a warm towel to keep it warm

Detailed, step by step, corn recipe

Makes 3 tortillas

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Utensils

- 1 big bowl
- Dry ingredients measuring cups
- Wet ingredients measuring cups
- Measuring spoons
- Thermometer
- A skillet
- A tortilla press
- A zip plastic bag

Ingredients

Measure the following ingredients one by one.

- 1.5 cups of corn flour
- 1 cup of warm water (110°F/43°C)
- 1 teaspoon of salt

Dough making procedure

1. In a large bowl add: 1 cup of flour, ½ tsp of salt and ½ cup of water.
2. Mix all the ingredients together using your hands.
3. If the dough is not forming into a ball and it looks lumpy and dry, add a tablespoon of water and continue mixing.
4. Once everything is coming together into one ball, pick up all the flour or dough stuck to the sides of the bowl and mash the dough against the bowl using your hand. Continue doing this until the dough is no longer sticky.
5. Take a piece of the dough and flatten it between your hands, if the dough sticks to your hands, add another teaspoon of flour and continue mixing; but, if the dough breaks down into pieces, add another teaspoon of water and continue mixing.
6. Try the dough, if it is needed, add more salt and mix.
7. Your dough is ready when it does not stick to the bowl or your hands, it is lump-free and workable.

Forming and cooking procedure

1. Preheat the skillet (medium heat)
2. Divide the dough into 3 equal-size balls.
3. Cut a plastic bag along the sides and put it in the tortilla press.
4. Put a ball of dough in the middle of the plastic bag in the press
5. Flatten the tortilla using the tortilla press
6. Peel the tortilla away from the plastic
7. Place the tortilla in the skillet and let it cook for 1 minute
8. Turn the tortilla over and let it cook on the other side for another minute
9. Wrap the tortilla in a warm towel to keep it warm

Detailed, paragraph format corn recipe

Makes 3 tortillas

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Dough making procedure

In a large bowl add 1 cup of flour, ½ tsp of salt, and ½ cup of water (110 °F/43°C). Then, mix all the ingredients together using your hands and form a ball. If the ball is not forming and the mix looks lumpy and dry, add a tablespoon of water and continue mixing. Once everything is coming together into one ball, pick up all the flour or dough stuck to the sides of the bowl and mash the dough against the bowl using your hand. Continue doing this until the dough is no longer sticky. Next, take a piece of the dough and flatten it between your hands; if the dough sticks to your hands, add another teaspoon of flour and mix. Likewise, if the dough breaks down into pieces, add another teaspoon of water and mix. Finally, taste the dough. If it is needed, add more salt and mix. Your dough is ready when it does not stick to the bowl or your hands, it is lump-free and workable.

Forming and cooking procedure

1. Preheat the skillet (medium heat)
2. Divide the dough into 3 equal-size balls.
3. Cut a plastic bag along the sides and put it in the tortilla press.
4. Put a ball of dough in the middle of the plastic bag in the press
5. Flatten the tortilla using the tortilla press
6. Peel the tortilla away from the plastic
7. Place the tortilla in the skillet and let it cook for 1 minute
8. Turn the tortilla over and let it cook on the other side for another minute
9. Wrap the tortilla in a warm towel to keep it warm

Detailed, image format, corn recipe

Makes 3 tortillas

Initial setup

- Wash your hands with warm water and soap for at least 20 seconds.

Utensils

- 1 big bowl
- Dry ingredients measuring cups
- Wet ingredients measuring cups
- Measuring spoons
- Thermometer
- A skillet
- A tortilla press
- A zip plastic bag

Ingredients

Measure the following ingredients one by one.

- 1.5 cups of corn flour
- 1 cups of warm water (110°F/43°C)
- 1 teaspoon of salt

Dough making procedure:

🕒 3-5 minutes



In a large bowl add 1 cup of flour, ½ tsp of salt and ½ cup of water.



Mix all the ingredients together using your hands. If the dough is not forming into a ball and it looks lumpy and dry, add a tablespoon of water and continue mixing.



Flatten a piece of dough between your hands, if it sticks to your hands, add another teaspoon of flour. If it breaks down into pieces, add another teaspoon of water. Try the dough and check if it requires more salt.



Your dough is ready when it does not stick to the bowl or your hands, it is lump-free and workable.

Forming and cooking procedure

1. Preheat the skillet (medium heat)
2. Divide the dough into 3 equal-size balls.
3. Cut a plastic bag along the sides and put it in the tortilla press.
4. Put a ball of dough in the middle of the plastic bag in the press
5. Flatten the tortilla using the tortilla press
6. Peel the tortilla away from the plastic
7. Place the tortilla in the skillet and let it cook for 1 minute
8. Turn the tortilla over and let it cook on the other side for another minute
9. Wrap the tortilla in a warm towel to keep it warm